MARCH, 1934.

GENERAL PHYSICS.

ADSORPTION.

859. Relation between Activated and van der Waals' Adsorption. J. Howard. *Faraday Soc., Trans.* 30. *pp.* 278–287, *Feb.*, 1934.—It is found experimentally that the presence of gas adsorbed at the surface of chromium oxide in an activated form causes a marked decrease in the amount of van der Waals' adsorption which can occur at a given temperature. Activated adsorption is shown to be a true surface phenomenon, which cannot be explained by the presence of impurities on the surface or by diffusion and solution into the interior. The experimental results given support the view that the para hydrogen conversion occurs at low temperatures among molecules adsorbed on the surface of a catalyst by van der Waals' forces, and at high temperatures by activated adsorption. T. H. P.

860. Adsorption of Hydrogen on Tungsten. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 30. *pp.* 74–79, *Jan.* 31, 1934.—A method for studying the adsorption of hydrogen on a clean tungsten surface has been developed which depends on the fact that the accommodation coefficient of neon is different for a bare surface and for a surface with an adsorbed film on it. It has been shown that on a bare tungsten surface, saturation occurs at a partial pressure of hydrogen of 4×10^{-4} mm. of mercury and probably much lower, so that the adsorption is of the nature of chemisorption. Important deductions can be drawn concerning the process of activation if any for this chemisorption of hydrogen on a bare tungsten surface. The accommodation coefficient of Ne with a W surface covered with a hydrogen film of the type investigated is 0·17 at 295° K., and 0·32 at 79° K. AUTHOR.

861. Sorption of Hydrogen by Reduced Nickel. Parts I, II and III. S. Iijima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 468. *pp.* 285–300, *No.* 474. *pp.* 34–43, *Dec.*, 1933, *and No.* 481. *pp.* 164–172, *Jan.*, 1934. *In English.*—The sorption of hydrogen by nickel has been investigated at temperatures between − 185° C. and 200° C. Over the higher temperature range the heat of adsorption was found to be 16,000 cal. The low-temperature adsorption isotherms are found to be smooth and show no discontinuities. The influence of heat treatment of reduced nickel on the quantity of hydrogen which it will sorb at 0° C. and a pressure of 20·30 cm. Hg. is to diminish the amount sorbed and also to shorten the time required to establish equilibrium. Assuming that the later slow stages in the sorption process are due to diffusion of hydrogen to the interior of the nickel, it is shown that heat treatment of nickel to temperatures of 500° C. is without influence on the rate at which hydrogen diffuses into it. F. J. W.

862. Sorption of Vapours by Activated, Highly-Evacuated Charcoal over Long Periods of Time. J. W. McBain and R. F. Sessions. *Am. Chem. Soc., J.* 56. *pp.* 1–4, *Jan.*, 1934.—The sorption of CH_2Cl_2, $CHCl_3$, CCl_4, $(C_2H_5)_3N$, $(C_2H_5)_2NH$, CS_2, C_3HCOOH and pyridine by an activated charcoal has been studied at various temperatures, sorption being allowed to proceed for as long as 4–5 years. Equilibria are attained in most cases within a few days, but in some cases not until a week has passed. The isotherms obtained satisfy the Langmuir equation. F. J. W.

863. Chemisorption on Charcoal. Acid Constituent of Charcoal. Part II. A. King. *Chem. Soc., J. pp.* 22–26, *Jan.*, 1934.—Oxygen is bound more firmly to dried charcoal than to undried and is evolved mainly as CO instead of CO_2. No oxalic acid was formed from the oxidised dry charcoal. It is concluded that it is formed only when water is irreversibly bound to the charcoal surface. [For Part I see Abstract 3871 (1933).] A. S. C. L.

864. Adsorption of CO_2 by Activated Charcoals in the Presence of CCl_4 and HCN. R. Chaplin. *Faraday Soc., Trans.* 30. *pp.* 249–260, *Feb.*, 1934.—Adsorption of CO_2 is not altered in mechanism but only impeded by CCl_4 or HCN separately. Together these suppress the irreversible adsorption, allowing only the additional simple adsorption. It is suggested that neither of these molecules can occupy alone all the active centres on the charcoal owing to their size, and evidence is adduced to support this view. A. S. C. L.

865. Wetting and Porosity. Adsorption and Total Heat of Wetting of Powders of Different Grain Size. B. Iliin and A. Kisselew. *Kolloid Zeits.* 66. *pp.* 28–40, *Jan.*, 1934.—A method is described for the measurement of the heat of wetting and the adsorption of various liquids by porous media and by powders of different grain size. Previous work has merely recorded the values of the adsorption and heat of wetting without attempting to relate this to grain size, and, in addition, the full values have not been obtained, since during the wetting of a porous powder the adsorption kinetics are very slow in action and the time taken is too long for the usual calorimetric methods to be applied. This is accomplished by studying the total heats of wetting and adsorption in relation to grain size for different fractions of active wood charcoal. An adiabatic calorimeter is used for the total heat of wetting determinations, etc. The transition from 0·68 mm. grain size to 0·44 mm. and finally to $< 0{\cdot}15$ mm. shows an increase in the quantity of adsorbed material and the heat of wetting per gm. of adsorbent. For iodine the increase is 4·6 % whilst for heptyl acid it is as great as 10 %. The curves derived for adsorption isotherms for aqueous solutions experimentally do not conform to the known types of isothermal equations derived theoretically. A characteristic termed " affinity " is established between the isotherms and grain size from which one can be deduced from the other for the same adsorbed liquid. The kinetics of adsorption and the relationships theoretically established from this work are discussed. S. G. B.

866. Influence of Salts on the Adsorption of Cupric Ions by Ferric Hydroxide. J. H. Hamence. *Faraday Soc., Trans.* 30. *pp.* 299–303, *Feb.*, 1934.—The adsorption of cupric ions by ferric hydroxide was studied by precipitating a known amount of ferric hydroxide by ammonia in the presence of copper sulphate. The solution was centrifuged and the copper determined in a known volume of the clear liquid. The influence of ammonia concentration, temperature, and various salts was studied. In the case of lead it was found that if sufficient lead salt were present no adsorption of copper took place. F. J. B.

V. 19

867. Phase Boundary Potentials of Monolayers of Fatty Acids on Metals. L. Jacobs. *Faraday Soc., Trans.* 30. *pp.* 303–310, *Feb.*, 1934.—The adsorption of fatty acids by metal surfaces was shown to be capable of being followed by measurements of phase boundary potentials. Uniform spreading from a solvent was obtained on a dry metallic surface and the specific surfaces of sheet gold, silver and platinum were calculated. Evidence was obtained in the case of myristic acid of two-dimensional phases as the concentration was increased. The limits of the existence of the phases were verified by an optical method. F. J. B.

See also Abstract 1094.

ATOMIC AND MOLECULAR STRUCTURE.

868. Theory of Atomic Disintegration. T. Sexl. *Zeits. f. Physik*, 87. 1–2. *pp.* 105–126, *Dec.* 13, 1933.—A quantitative theory of artificial disintegration is given. An absorption coefficient of the incident particle by the nucleus is calculated as a function of the energy of the particle. This absorption coefficient represents the interaction between the incident particle and the nucleus. A form of excitation function is calculated. A comparison is made with experimental results of disintegration of B, N, F and Al by α-particles. The case of B presents theoretical difficulties on account both of the uncertain experimental values of the radius of the nucleus, and the small atomic charge which invalidates the asymptotic development of the wave functions. The calculated excitation function for N is claimed to represent the emission of two groups of protons, one being from a resonance level. In the case of F the calculated half width of the resonance groups of protons agrees with experimental values. The proton groups from Al remain unexplained. Disintegration of Li and B by protons is not easily calculable on account of their small nuclear charge. J. E. R. C.

869. Disintegration of Lead Atoms. A. Smits, (Miss) H. S. V. Meinesz, (Miss) J. A. A. Kruger and H. G. Roebersen. *Zeits. f. Elektrochem.* 40. *pp.* 71–73, *Feb.*, 1934.—Lead plates exposed to the action of X-rays showed an activated state, not exhibited by aluminium. The activity was not influenced by a current of air, so was not due to radioactive dust from the atmosphere. *In vacuo* no similar activation took place. The two contradictory results were not explained. Exposure to sunlight at different heights, in highly exhausted vessels, showed that activation of lead by sunlight was extremely improbable. The activity exhibited by old lead roofs was considered as due more probably to the deposit of radioactive dust from the air than to the action of sunlight. F. J. B.

870. Bombardment of the Heavy Isotope of Hydrogen by α-Particles. (Lord) Rutherford and A. E. Kempton. *Roy. Soc., Proc.* 143. *pp.* 724–730, *Feb.* 1, 1934.—Experiments have been made to test whether the diplon can be broken up into a neutron and proton in the bombardment of diplogen by the α-particles from polonium. No certain evidence was obtained of the production of neutrons when heavy water was bombarded by α-particles. The number of neutrons, if any, was certainly less than 1 in 10^7 of the number of bombarding α-particles. The maximum range of recoil in air of the diplon in a head-on collision with an α-particle from polonium is about 7 % greater than that of recoil of the proton. This is in agreement with calculations based on observed data with the proton. As is to be expected, the stopping power of the α-particle is the same in diplogen as in hydrogen. The scattering of α-particles by diplogen was compared with the scattering of α-particles by hydrogen. Apart from the greater range of travel of the diplon under similar conditions of recoil, no certain difference could be detected by our experimental method. It is concluded that the field of force surrounding the diplon is sensibly the same as that of the proton.

AUTHORS.

871. Isotope of Hydrogen. P. Zeeman and J. de Gier. *K. Akad. Amsterdam, Proc.* 37. 1. *pp.* 1–3, 1934.—The mass defects of isotopes previously announced [see Abstract 5103 (1933)] are shown by Thomson parabolæ, which were measured by a comparator and give results in good agreement with calculations. The photograph for hydrogen obtained by conducting a stream of the vapour of distilled water over sodium gave a faint parabola with $m/e = 4$. N. M. B.

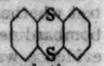
872. Preparation of Heavy Hydrogen. P. Harteck. *Phys. Soc., Proc.* 46. *pp.* 277–280, *March* 1, 1934.—The method of working for the preparation of heavy hydrogen by means of the electrolysis of an alkaline solution with nickel electrodes is described in detail. AUTHOR.

873. Possibility of Spontaneous Emission of Neutrons by Non-Radioactive Elements. W. Swietoslawski and (Miss) A. Dorabialska. *Acad. Polonaise Sci. et Lettres, Bull.* 4–8A. *pp.* 173–176, *April–Oct.*, 1933. *In English.*—Since the atomic weights of some known isotopes do not entirely agree with those to be expected from radiation emissions it is suggested that the emission of neutrons from the nucleus attends the transmutation of elements and isotopes. This is held to explain the constant proportion of isotopes of a given element; the existence of only one isotope may represent the last stage of neutronic decomposition of short-life isotopes of higher atomic weight. Neutrons emitted from atomic nuclei may incite the falling of an inner electron into the nucleus.

N. M. B.

874. Slow Neutrons Emitted by Beryllium. P. Auger. *J. de Physique et le Radium*, 4. *pp.* 719–724, *Dec.*, 1933.—An examination has been made of the proton emisssion observed in a hydrogen filled expansion chamber which is irradiated with neutrons from Be. It is stated that the tracks observed can be divided into two classes: (1) those due to fast protons and (2) those due to slow protons. Distribution curves are reproduced which show the presence of a group of slow protons having a range in hydrogen of the order of 5 mm. These are ascribed to a group of slow protons present in the emission from the Be. It is suggested that these slow neutrons arise from the disintegration of a Be^9 nucleus caused by the impact of an α-particle which is not captured by the nucleus.

J. E. R. C.

875. Valency Angle of Sulphur. G. M. Bennett and S. Glasstone. *Chem. Soc., J. pp.* 128–129, *Jan.*, 1934.—Thianthrene 

has a dipole moment of $1{\cdot}50 \times 10^{-18}$ e.s.u. in CS_2 and CCl_4 solutions. The molecule cannot therefore be a plane one, and it is suggested that the two benzene rings are inclined to one another along the line joining the S atoms. A. S. C. L.

876. Free Radicals. *Faraday Soc., Trans.* 30. *pp.* 3–246, *Jan.*, 1934.—A general survey of the subject comprising 29 papers arranged under three main headings, preceded by an Introductory Address and followed by a General Discussion, in which various contributors participated, as follows :—

Introductory Address : "Free Radicals and Ions as Factors in Chemical Change," by **T. M. Lowry** (*pp.* 3–9). Reviews the various theories of the mechanism of organic reactions, and the relation to them of the papers contributed to the discussion.

PART I. FREE RADICALS OF RELATIVELY LONG LIFE.

"Chemistry of Radicals with Tervalent Carbon," by **K. Ziegler** (*pp.* 10–17). Deals with the stability of the C-C linkage in compounds of the hexaphenylethane type.

"New Class of Free Radicals," by **A. Schönberg** (*pp.* 17–18). Reactions producing free radicals containing a free sulphur bond are reported.

"Magnetism of Free Radicals," by **S. Sugden** (*pp.* 18–23). Free radicals can be defined as molecules containing odd numbers of electrons. Magnetic properties of "odd" inorganic and organic molecules are reviewed, and preliminary results on those of free radicals are reported.

"$(ClO_4)_n$ Radical," by **M. Gomberg** and **H. R. Gamrath** (*pp.* 24–30). Experiments are described in which the $(ClO_4)_n$ radical is definitely produced.

"Sulphur Monoxide," by **H. Cordes** and **P. W. Schenk** (*pp.* 31–33). Properties of the SO radical, including its electronic band spectrum, are described.

"Oxygen Molecules as Radicals," by **W. Steiner** (*pp.* 34–39). Spectroscopic evidence for the existence of O_4 is adduced, a new spectrum in highly compressed oxygen being attributed to two O_2 molecules at the moment of collision. The series converges to the value of the energy of dissociation of O_2, and the spectrum is related to that observed by Herzberg in long columns of the gas at lower pressures. The spin-interaction of two O_2 molecules is calculated.

"Theory of Free Radicals of Organic Chemistry," by **E. Hückel** (*pp.* 40–52). An account of the application of wave-mechanics to C-C bonds is given, and this is then employed to discuss further the energies of dissociation of the hexaphenylethane derivatives. Static bond strains for a number of aromatically and aromatically-aliphatically substituted ethanes are tabulated, and the equilibria of dissociation are investigated.

"Relation between Chemical and Physical Theories of the Source of the Stability of the Organic Free Radicals," by **C. K. Ingold** (*pp.* 52–60). Physical principles are applied in a qualitative way to an investigation of the stability of the kation and anion corresponding to a radical such as triphenylmethyl, and the treatment is then generalised to include the neutral radical and more complex hydrocarbon and other radicals.

"Three-Dimensional Models of the Potential Energy of Triatomic Systems," by **C. F. Goodeve** (*pp.* 60–69). A set of models is described which enables the potential energies of the following systems to be demonstrated : 3 H atoms, one C and 2 O atoms, 2 Na and 1 Cl atoms. Various applications are discussed.

"Electronic Structure and Interaction of Some Simple Radicals," by **J. E. Lennard-Jones** (*pp.* 70–93). The method of non-localised molecular orbitals is applied to a number of simple radicals. A detailed study of their electronic structure and spectral states leads to a classification of dissociation processes into two distinct types in one of which there is a certain energy of reorganisation.

"Electronic Levels of Polyatomic Molecules. Some Levels of the C = C Double Bond," by **C. P. Snow** and **C. B. Allsopp** (*pp.* 93–99). The variation of the symmetry of a C = C double bond is shown not to influence its absorption spectrum. Tentative assignments to transitions are made for weak bands in trimethylethylene and cyclohexene.

"New View of the Nature of the Co-Valent Linkage, and the Formation of Free Radicals," by **M. W. Travers** (*pp.* 100–102). Results of experiments on the pyrolysis of ethane and of ethane-ethylene-hydrogen equilibrium mixtures are described. The simple electronic ideas on which organic reactions in the liquid phase can be explained do not seem adequate for molecules in free space.

PART II. FREE RADICALS OF SHORT LIFE: CHEMICAL ASPECTS.

A. General and Inorganic.

"Primary Photochemical Production of Free Radicals," by **R. G. W. Norrish** (*pp.* 103–120). Experiments on the photochemical decomposition of simple polyatomic molecules show that while light absorption is occasioned by one particular group, the effects may appear in chemical reaction in a different part of the molecule. In photochemical calculations, the thermal value of the carbon links as calculated from the heat of sublimation of C require adjustment for a $^5S \rightarrow {}^3P$ transition of the C atom. The production of free radicals in photochemical processes, and their stability, is discussed. Evidence is adduced for the existence of C in a ^3P state in some radicals. Acetone is observed to fluoresce during photochemical decomposition. This occurs when a molecule drops from a stable excited level to an unstable lower level and is a possible mechanism for the production of free radicals.

"Free Radicals and the Photochemistry of Solutions," by **J. Franck** and **E. Rabinowitsch** (*pp.* 120–131). The rôle of free atoms and radicals in photochemical reactions in liquid systems is discussed from the point of view of dissipation of absorbed energy by collisions of the second kind and of primary and secondary recombination. In liquids, the probability of reactions proceeding through activated molecules is higher, and the rate of formation of free atoms and radicals is lower, than in gases.

"Addition Reactions of Hydrogen and Oxygen Atoms at Low Temperatures," by **K. H. Geib** and **P. Harteck** (*pp.* 131–134). The interaction of H and O atoms with various gaseous substances at low temperatures is shown to give rise in many cases to addition products which are only stable at low temperatures.

"Hydrogen Atoms, Oxygen Atoms and the Hydroxyl Radical," by **P. Harteck** (*pp.* 134–140). Other reactions of H and O atoms, and the OH radical, are discussed.

"Formation of Hydroxyl Radical from the Photolysis of Water, and the Generation of Formaldehyde," by **N. R. Dhar** (*pp.* 142–147). Atmospheric water vapour appears to be photochemically decomposed into H and OH in sunlight. The atomic hydrogen may reduce CO_2, forming formaldehyde, which can be detected in rain-water. The energy required for this is the same as that required to break the H-OH bond.

B. Hydrocarbons.

"Free Radicals in the Thermal Decompositions and Combustion of Hydrocarbons," by **W. A. Bone** (*pp.* 148–152). A discussion of the mechanism of formation of free radicals in thermal decomposition and combustion of simple hydrocarbons.

"Decomposition of Organic Compounds into Free Radicals," by **F. O. Rice** (*pp.* 152–169). Relative proportions of the products in thermal decompositions of hydrocarbons, ketones and ethers are calculated accurately on the basis of chain reactions involving free radicals.

"Thermal Catalytic Decomposition of Methane," by **L. Belchetz** (*pp.* 170–176). A methylene radical is a primary product when methane is decomposed on a hot platinum filament. Two such radicals react on a cooled glass surface to produce ethylene.

"Use of Free Methyl and Ethyl in Chemical Synthesis," by **F. A. Paneth** (*pp.* 179–181). An account of the reactions of free CH_3 and C_2H_5 radicals with arsenic, antimony and bismuth.

"Possible Application of Molecular-Ray Technique to the Study of Free Radicals," by **R. G. J. Fraser** (*pp.* 182–187). The Estermann and Stern method of detecting molecular rays, depending on the neutralisation of space charge around a heated wire by positive ions, could be employed, either alone, or combined with an auxiliary magnetic analysis, for the anaylsis of beams containing free radicals. The application of such a method to the identification of the products of thermal decomposition of CH_4 and C_2H_6 is discussed.

"Creation of Free Radicals in Highly Diluted Gas Reactions," by **H. v. Hartel** (*pp.* 187–189). Experiments are described in which free organic radicals are produced by means of a reaction in a gas space.

"Isolation of Free Methyl and Ethyl by the Reaction between Sodium Vapour and Methyl and Ethyl Bromides," by **E. Horn, M. Polanyi** and **D. W. G. Style** (*pp.* 189–199). Radicals formed by this method were detected up to 8 cm. from the source. The yield depends on the partial pressure of sodium. The bimolecular velocity constant for recombination of the radicals is of the order of that for a reaction occurring at every collision.

PART III. FREE RADICALS OF SHORT LIFE: PHYSICAL ASPECTS.

"Free Radicals and Spectroscopy," by **R. Mecke** (*pp.* 200–214). The application of spectroscopic methods to the study of free radicals is reviewed and compared with the positive ray method. The spectroscopic method is limited to simple radicals, and no spectrum of a radical with more than two atoms has been definitely established. The following information has been obtained. Inter-nuclear distances and valency angles are the same in the free radical as in the complete molecule, so that radicals retain their dimensions as they build up into molecules. Similar linkages have similar elasticity moduli, and the strengths of bonds are additive quantities in a molecule. Examination of the third overtone of the characteristic C-H frequency for a number of simple hydrocarbons establishes that the position of the absorption remains the same irrespective of the number of C-H linkages present and of the symmetry of the molecule. Different types of linkage (HC —, HC =, HC≡) can thus be identified without ambiguity. Dissociation energies for H_2O, CO_2, and H_2CO are calculated and discussed. In order that decisive results may be obtained, the radicals must react in the ground state.

"Decomposition of Hexane, Cyclohexane, and Benzene in the Positive Ray Tube," by **R. Conrad** (*pp.* 215–220). Mass spectrograms for these compounds show lines for a large number of radicals. Alternating intensities in these lines allow of definite conclusions as to the step-by-step decomposition of the initial compounds in the electrical discharge, in which the stability of the intermediate products plays a part, on the basis that a positive charge indicates saturation of a C valency, and that a C atom with a free valency tends to form a double bond with the neighbouring atom by expulsion of a H atom.

"Free Radicals in Electrical Discharges," by **W. D. Harkins** (*pp.* 221–227). The principal radicals found in electrical discharges through organic vapours, as detected spectroscopically, are all diatomic, *e.g.*, CH, OH, C_2, NH, CN. No bands due to CH_2, CH_3, or NH_2 are observed, although positive ray methods reveal their existence. This may be due to the small number formed or to their dissociation on taking up an electron. Electron impact is probably the most important factor in breaking up a molecule, but collisions of the second kind also play a part. There is no necessity to assume the formation of large ions and clusters in the electrical discharge.

"Determination of the Probability of Energy Transfer during Collisions," by **N. N. Semenoff** (pp. 227–230). A mathematical discussion of a possible experimental method for determining this probability.

"Free Radicals in the Electric Discharge," by **E. J. B. Willey.** (*pp.* 230–246). The formation of CH, OH and NH in electrical discharges is discussed, and an attempt is made to explain the Schuster and α-bands of NH_3 on the basis of a reaction between NH and NH_3 to form an excited N_2H_4 molecule. The formation of clusters of ions in discharges through hydrocarbons is also considered. C. B. A.

877. Relation between Constitution and Association; Especially in Aromatic Compounds. E. C. Bingham and J. A. Geddes. *Physics*, 5. *pp.* 42–52, *Feb.*, 1934.—Measurements have been made of the fluidities of a number of *o*-, *m*- and *p*- compounds and compared with the values calculated by the authors' method. From these the degree of association is calculated. Constants have been determined for fluorine. The effects of mono-, di- and poly-substitution by halogens is discussed.

A. S. C. L.

878. Atomic and Molecular Radii. V. Posejpal. *J. de Physique et le Radium*, 4. *pp.* 741–748, *Dec.*, 1933.—Previous work [see Abstract 5055 (1932)] based on the concept of a hypothetical corpuscular polarised ether permeating the atom, and giving a formula for the atomic radius, is extended to the calculation of the atomic radius R of the rare gases. Mean atomic collision durations are also calculated, and the variation of these with the atomic number Z leads to the following corrected values of $R \times 10^8$: Ne $0 \cdot 92$, A $1 \cdot 61$, Kr $3 \cdot 64$, Xe $7 \cdot 32$ cm., agreeing with the general relation $R = 0 \cdot 769 + 0 \cdot 002245\, Z^2$. This can be applied to other gases, data for which are tabulated. These are in good agreement with available data obtained by various investigators, and confirm the theory of photon penetration [see Abstract 1671 (1933)] Molecular diameters are given as for spheres of the same volume as that of the combined atoms. N. M. B.

879. Covalent Radii of Atoms and Interatomic Distances in Crystals Containing Electron-Pair Bonds. L. Pauling and M. L. Huggins. *Zeits. f. Krist.* 87. *pp.* 205–238, *Feb.*, 1934. *In English.*—A simple quantum-mechanical discussion of the orbitals (one-electron orbital eigenfunctions) of an atom is shown to lead to the possibility of formation of various sets of covalent bonds, differing in number and spatial distribution. Among these are tetrahedral sp^3 bonds, octahedral d^2sp^3 bonds, square dsp^2 bonds, etc. After a discussion of the criteria which may be applied to distinguish crystrals of essentially covalent rather than ionic or metallic character, observed interatomic distances are used as a basis for formulating sets of radii corresponding to different bond types, including tetrahedral, octahedral, square, trigonal-prism, and normal-valence bonds. It is found that these radii show various reasonable interrelations, and that they are in general agreement with the interatomic distances determined experimentally, cognisance being taken when necessary of resonance among several electronic structures. A remarkable and puzzling exception is the octahedral radius of manganese in the pyrite-type crystals MnS_2 and $MnTe_2$, the observed value being over 0·30 Å larger than expected. A somewhat detailed discussion is then given of the structures of several crystals, including palladous oxide, niccolite, breithauptite, iodyrite, wolfsbergite, eulytite, and the triiodides of arsenic and bismuth. AUTHORS.

880. Thermal Data and Atomic Weight of Krypton. W. Heuse and J. Otto. *Phys. Zeits.* 35. *pp.* 57–59, *Jan.* 15, 1934.—Using a gas thermometer, in which the pressures were fixed by means of platinum points fused into the manometer tube, the 0° isotherm and the expansion and pressure coefficients of Kr were measured at a pressure of about 1 m. Hg. The density was also determined and the atomic weight calculated to be 83·66 ± 0·01. R. W. P.

See also Abstracts 903, 1069, 1070, 1072, 1075, 1081, 1085, 1092, 1098, 1126, 1151, 1172, 1174, 1178, 1203, 1204, 1205, 1294, 1297, 1303.

COLLOIDS.

881. Preparation of Disperse Systems by Explosion. Part I. P. P. v. Weimarn and N. Sata. *Kolloid Zeits.* 66. *pp.* 1–11, *Jan.*, 1934.—The vapour condensation method previously suggested [see Abstract 1351 (1910)] has been developed experimentally and colloidal solutions of Hg, Se and S have been prepared. Also disperse systems of these elements have been obtained by the Geiser method (explosive boiling of liquid within the cold dispersion medium), and by the vapour-explosion method in which vapours are exploded in the interior of the cold dispersion medium. The colloidal Hg and Se solutions thus obtained have concentrations of about 0·005 and 0·006 % respectively, and are highly stable. The stability is attributed to the presence in the dispersion medium of soluble compounds having atoms in common with the colloidally distributed substances; in absence of such compounds the colloidal solutions are unstable. T. H. P.

882. Relation between Streaming Potential and Applied Pressure. H. B. Bull. *Kolloid Zeits.* 66. *pp.* 20–22, *Jan.*, 1934.—Repetition of Ettisch and Zwanzig's streaming potential measurements [see Abstract 12 (1933)] with methyl and isopropyl alcohols fails to confirm their results. The curves connecting streaming potential and pressure are rectilinear and pass through the zero point. T. H. P.

883. Electric Charge and Isoelectric Points of Fine Fibres. A. and O. A. Dumanski. *Kolloid Zeits.* 66. *pp.* 24–28, *Jan.*, 1934.—A new method for the determination of the sign of the electric charge and the isoelectric point of fine fibres is outlined. The method consists of suspending the fibre in a bath of water or electrolyte. The fibre is mounted between two electrodes, the potential of which remains the same but can be reversed. The inclination of the free end of the fibre to one electrode or the other determines its sign. A more elaborate design on the same principle is used for the determination of the isoelectric point. The results show that hair and artificial silk are positive, whilst glass, collodion and gelatin are negative. The isoelectric points are given as pH. 5·1 for silk, 4·9 for wool, and 6·4 for fibroin. The method is described as cataphoresis of fixed fibres. The results obtained are in good agreement with those derived from other sources. In comparison with the Humphrey method the present work is fundamentally different. The Humphrey-Warburg phenomenon is independent of the direction of the current, the present method is strongly dependent. The former method is influenced by the conductivity, the present method is independent. S. G. B.

884. Influence of Electric Charge on Viscosity of Hydrophilic Colloids. I. Sakurada and T. Nakashima. *Kolloid Zeits.* 66. *pp.* 62–67, *Jan.*, 1934.—A relationship between viscosity and concentration for colloidal solutions of particles of any form, and with or without electric charge, may after simplification be expressed as an extended Einstein equation, $\eta_r = 1 + a\,\phi\,c/100$, and also as an extended Fikentscher-Mark equation, $\eta_r = 1 + a\,\phi\,c/(100 - \phi\,c)$, where "$a$" is a constant which depends on the particle form and electric charge, and amounts to 2·5 for charge-free spheres; ϕ is the volume of 1 gm. of substance in solution and is dependent on its solvation. The latter equation may be rearranged into $C/\eta_{sp} = 100/a\phi - c/a$, where $\eta_{sp} = \eta_r - 1$, and by its means the magnitudes of "a" and "ϕ" are determined; its validity has been established for sodium cellulose glycollate, starch, and gelatin solutions. Sodium cellulose glycollate colloidal particles in pure aqueous solutions appear to be spherical and strongly charged. A small amount of neutral salt suffices to discharge the particles completely, and increase of temperature has also a discharging effect. NaOH is not so effective as neutral salts, which also only slightly decrease the specific volume. Starch particles in aqueous solution appear to be almost spherical and not very strongly charged, whilst gelatin particles are either strongly charged or not spherical.
H. H. Ho.

885. Aggregation of Colloidal Electrolytes from Transport Number and Conductivity Measurements. C. Robinson and J. L. Moilliet. *Roy. Soc., Proc.* 143. *pp.* 630–653, *Feb.* 1, 1934.—By using the moving boundary apparatus of MacInnes and Brighton, transport numbers of benzopurpurine 4B, its isomer prepared from *m*-tolidine, and Bordeaux Extra, reproducible to 1 part in 500, have been measured over a range of concentrations. From these and concurrent conductvity measurements it is concluded that Bordeaux Extra solutions contain negative micelles, more mobile than the simple anions, and practically no Na is held by these micelles. On dilution the micelles break down gradually into simple ions. Meta dye solutions contain negative micelles, more mobile than the simple anions. An appreciable fraction of Na is included in the micelles. On dilution the micelles gradually break down into simple ions. Benzopurpurine 4B solutions contain negative micelles, more mobile than the simple anions would be, with appreciable amounts of bound Na. The micelles are more stable than those of the other two dyes, and down to 0·0005 *N* no proof can be obtained that they are breaking down on dilution. The number of simple R radicals included in the mean effective micelle of each dye is in the order 4B > meta > Bordeaux Extra. Above 0·003 *N* the mean effective micelles of the 4B and meta dyes do not differ greatly; below this concentration the 4B micelle is definitely larger. AUTHORS.

886. Dialysis in the Study of Colloids. Part II. Colloidal Thorium Hydroxide. B. N. and A. K. Desai. *Faraday Soc., Trans.* 30. *pp.* 265–271, *Feb.*, 1934.—Measurements of cataphoretic velocity, stability and viscosity changes with dialysis. Coagulation of different specimens begins at approximately the same cataphoretic velocity. There is no simple connection between charge and viscosity. With dialysis, viscosity rises slowly at first and then rapidly. The latter effect is not observed in very dilute sols. [For Part I see Abstract 22 (1934).] A. S. C. L.

887. Diffusion in Molecular Disperse Solutions. R. O. Herzog, R. Illig and H. Kudar. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 329–342, *Jan.*, 1934.—The diffusion relationships of molecular disperse solutions are discussed from the molecular-kinetic standpoint [see Abstracts 1327 and 3384 (1933)]. Experimental data are given for solutions of a large number of organic compounds in organic solvents, and these indicate that the Einstein-Sutherland relation [see Abstract 1649 (1905)] for the diffusion of molecular disperse solutions is to be assumed in the ideal case. The physical character of the deviations, which are all in the same direction, is brought into relationship with the dipole moments. T. H. P.

888. Diffusion of Rod-Shaped Colloids. R. O. Herzog and H. Kudar. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 343–354, *Jan.*, 1934.—For the paraffin $C_{34}H_{70}$, the formula for the diffusion coefficient of rod-shaped molecules, $D = kT(\log c/a + 0{\cdot}69)/6\pi\eta c$, where c is half the long axis and a the radius of the rod, is in agreement with the experimental results if the slipping is allowed for. With eu-colloids the fall in concentration of the original layer, based on Stefan's distribution formula, is used to calculate mean diffusion coefficients, which are in satisfactory agreement with the experimental values. There is hence available a further method for determining the length of rod-shaped colloids, when the diameter of the molecule is known. The absolute values obtained are not highly exact, since a occurs only in the expression $\log (c/a)$. T. H. P.

889. Action of Electric Field upon Periodic Diffusion. Suzanne Veil. *Comptes Rendus*, 198. *pp.* 258–260, *Jan.* 15, 1934.—Liesegang rings formed by diffusion of K_2CO_3 through gelatin gel are distorted by a potential of 0·1 volt. A. S. C. L.

890. Diffusion of Proteins. A. Tiselius and D. Gross. *Kolloid Zeits.* 66. *pp.* 11–20, *Jan.*, 1934.—An optical method is described for determining fairly rapidly and accurately, the diffusion coefficients of colloids of high molecular weight exhibiting light-absorption in the visible or ultra-violet spectrum. This method has been used for measurements in phycoerythrin under widely varying experimental conditions, and on four other proteins, the values thus obtained for the diffusion constants being in general lower than those calculated from the molecular weights and sedimentation velocities. T. H. P.

891. Elastic Properties of Collodion during Flow. A. Pakschwer and M. Bunin. *Kolloid Zeits.* 66. *pp.* 68–75, *Jan.*, 1934.—It is shown that collodion, during mixing and other mechanical processes, exhibits thixotropic phenomena, and that on standing a mechanically treated collodion again increases its effective viscosity η up to the initial value. The influence of temperature and concentration upon the values of η and v (the elastic limit), shows that the former strongly affects η, but is without influence on v; on the other hand, concentration greatly influences both η and v. The flow of collodion has been investigated in short and long tubes, whereby characteristic velocity distribution and pressure changes have been derived. It is shown that the ideal plastic collodion of theory possessing two material constants η and v, does not exist, since these values are variable. It is assumed that a theory for real plastic substances which exhibit thixotropic phenomena may perhaps be derived by a consideration of energetics. H. H. Ho.

892. Swelling Peculiarities of Gelatin Foil. J. Bollhagen. *Kolloid Zeits.* 66. *pp.* 75–83, *Jan.*, 1934.—Three curvatures have been established for gelatin foil, each of which possesses a special axis. One of the concave axes of curvature of the dry side is at right angles to the one on the wet side, while the third axis (on the dry side) has the same direction as the first axis. The swelling phenomena now described were determined by polarisation microscope observations. Two stages in the course of swelling are distinguished, *viz.*, a simultaneous decrease in one and increase in another particle dimension, and differences in the magnitudes of the swelling particles. The biological significance of these regularities is pointed out. H. H. Ho.

893. Stratification Phenomena in Pigment-Containing Celluloid Layers. E. Miehlnickel. *Kolloid Zeits.* 66. *pp.* 84–86, *Jan.*, 1934.—Experiments for the preparation of celluloid layers containing pigments for X-ray purposes are described, in which the necessary homogeneous distribution and smooth surface are produced. The homogeneity is found to be disturbed by pigment wandering, and a special drying method has been developed to avoid this contingency. The density of the layer was then found to rise linearly with the mixture relationship of the fundamental substances, so that structural changes due to air inclusions and similar causes appear to have no effect. On the other hand, the drying-time showed an unexpected dependence on the composition of the substance. H. H. Ho.

894. Size Distribution of Particles in Fine Powders. R. T. Knapp. *Indust. and Engin. Chem.* (*Analytical Edition*), 6. *pp.* 66–71, *Jan.* 15, 1934.—An instrument, called the microneter, is described which is capable of determining rapidly the size distribution of particles in a powder, such as cement. The method employed is to form a column of liquid which contains the particles homogeneously distributed throughout it, and to determine the rate of settling by changes in the hydrostatic pressure just above the bottom of the column. F. J. W.

895. Sedimentation Method of Determining Particle Size. D. L. Bishop. *Bureau of Standards, J. of Research,* 12. *pp.* 173–183, *Feb.*, 1934.—This paper reports a comparison between a sedimentation method of determining particle size distribution and a microscopic method and also some data on hydrated lime. Glass spherules were prepared from pyrex glass and fractionated so that most of the particles had a diameter within 2 microns of the average diameter of the fraction. These particles were then dispersed in a liquid and weighed as they settled out of suspension with an automatic-weighing device. From this sedimentation record the particle-size distribution was calculated. The same sample was then used to determine the particle-size distribution by measuring the diameters of several hundred particles with a microscope. In making the microscopic measurements the glass spherules were mounted in liquids of various refractive indices and it was found that differences in refractive index of the mounting medium produced appreciable changes in the apparent diameter (more than 20 per cent in some cases). The microscopic and sedimentation measurements showed similarly shaped distribution curves but there was some variation between them. Particle-size distributions of hydrated lime are also reported. AUTHOR.

See also Abstract 935.

CRYSTAL STRUCTURE AND PROPERTIES.

896. Energy-Distribution of a Two-Dimensional (Surface) Lattice, with Atoms Having Electronic Orbital Impulse. H. Ludloff and G. Reymann. *Zeits. f. Physik*, 87. 3–4. *pp.* 154–175, *Dec.* 23, 1933.—The treatment is for a " surface model " of a solid body. There is no spin. The total impulse vanishes on the average, and consequently there is no ferromagnetism. The question of degeneracy is discussed, and compared with earlier work dealing with zero-point energy.
F. I. G. R.

897. Thermodynamic Equilibrium in the Crystalline State. D. Balarew. *Kolloid Zeits.* 66. *pp.* 51–57, *Jan.*, 1934.—The main conclusions reached are (1) that at ordinary temperatures PbI_2 crystals in aqueous solution grow only in layers of about 300$\mu\mu$, and (2) are built up mosaic-fashion from minute equal blocks. F. I. G. R.

898. Barker's Determinative Method of Systematic Crystallography. P. Terpstra, J. D. H. Donnay, J. Mélon and W. J. van Weerden. *Zeits. f. Krist.* 87. *pp.* 281–305, *Feb.*, 1934. *In English.*—Part I gives a general account of the system (overdevelopment and underdevelopment), and Part II directions for the preparation of tabular matter.
F. I. G. R.

899. Twinning as a Special Case of Central Rotation of Two Crystals. E. Baier. *Zeits. f. Krist.* 87. *pp.* 306–325, *Feb.*, 1934.—A discussion based on the method of the universal rotating stage. The symmetry of the indicatrix is treated for the most general case, and it appears that by combination of a number of twinning laws, arrangements very closely akin to twins can be generated without being capable of description as true instances of twinning. F. I. G. R.

900. Madelung Constant of Cuprite : A Correction. J. Sherman. *Zeits. f. Krist.* 87. *p.* 342, *Feb.*, 1934. *In English.*—The correct value is A=5·12972 [see Abstract 427 (1933)]. F. I. G. R.

901. X-Ray Examination of Electrolytic Silver Deposits. G. R. Levi and M. Tabet. *Accad. Lincei, Atti*, 18. *pp.* 463–467, *Nov.* 19, 1933. —X-Ray examination of the bright silver deposits obtained from AgBr in baths rich in Na_2SO_3 shows that the particles are, with close approximation, isodiametric in form and thus differ greatly from those of Cr deposits, in which the flatness of the granules is a necessary condition for the brilliancy of the deposits [see Abstract 3298 (1933)]. The growth takes place in a direction perpendicular to the octahedral faces. T. H. P.

902. Structure of Electrodeposited Metals. A. Glazunov. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 399–406, *Jan.*, 1934.—The crystallisation velocity and the number of crystallisation centres operative during the electrodeposition of a metal are influenced by many more factors than in the case of ordinary processes of crystallisation. These include the current density, the nature of the anion, the concentration of electrolytes, especially near the kathode, and the form of the lines of current flow. In addition to the crystallisation velocity in the direction of the current lines, there is a second component normal to this direction. Details are given of a method of measuring photomicrographically the rate of crystallisation of a metal during its deposition on, *e.g.*, a platinum surface, and of determining the number of crystallisation centres. The rate and the number of centres increase with increase of current density. The rate in the direction of the current lines, V_1 (generally normal to the surface of the kathode), falls with rise of concentration, and that at right angles, V_2, rises, whilst the number of centres falls. V_2 is much smaller than V_1. Production of a mirror-like deposit is dependent upon a high value of V_2. If V_2 is small and the number of centres large, a powdery deposit is obtained. H. F. G.

903. Structure of NdAl. C. W. Stillwell and E. E. Jukkola. *Am. Chem. Soc., J.* 56. *pp.* 56–57, *Jan.*, 1934.—NdAl, d^{25} 6·05, is cubic, $a=3\cdot73$ Å, with one molecule in the unit cell. The structure is that of CsCl or β-brass. The ratio of the number of valency electrons to atoms, assuming the valency of the transition element, Nd, to be zero, is 3·2. C. A. S.

904. X-Ray Study of Aluminium-Zinc Alloys. E. A. Owen and J. Iball. *Phil. Mag.* 17. *pp.* 433–457, *Feb.*, 1934. *Supplement.*—The paper describes a preliminary survey of the Al-Zn system, the alloys being examined by the powder method. Below the eutectoid transformation temperature the alloys are investigated after quenching from the desired temperature. Above the eutectoid transformation temperature the alloys are examined in a high-temperature camera. At 250° C. the system consists of the following regions; (1) α-phase (close-packed hexagonal, 0 % to 2 % Al; (2) (α+γ) region, 2 % to 80 % Al; (3) γ-phase (face-centred cubic); 80 % to 100 % Al. The eutectoid transformation temperature is found to lie between 300° C. and 310° C. The β-phase is a solid solution having a face-centred cubic structure, and extends at 375° C. from 19 % to 45 % Al. In the (β+γ) region two face-centred cubic lattices with different parameters exist together. At higher temperatures the range of solution of Zn in Al appears to be much smaller than that given by most previous workers. J. T.

905. Lattice Spacing of $NaNO_3$. J. Weigle. *Helv. Phys. Acta,* 7. 1. *pp.* 46–50, 1934. *In French.*—Precise values for the lattice constants of non-cubic crystals can be obtained by an extrapolation method from X-ray measurements. In the case of $NaNO_3$ it is found that the length of the edge of the rhombohedral unit cell is 6·3108 Å, and the inter-axial angle is 47° 15′ 59″. J. T.

906. Lattice Spacing of Zn. J. Weigle. *Helv. Phys. Acta,* 7. 1. *pp.* 51–56, 1934. *In French.*—The method referred to [see preceding Abstract] is applied to the determination of the lattice constants of Zn. These are found to be: $a=2\cdot6585_0$ Å, $c=4\cdot9341_5$ Å, giving $c/a=1\cdot8559_9$. The accuracy claimed in the determination of the lattice constants is 0·002 %. The values are obtained from the measurements of Owen and Iball. J. T.

907. Vicinal Faces of Topaz. S. Kreutz. *Acad. Polonaise Sci. et Lettres, Bull.* 4–8 *A. pp.* 169–172, *April–Oct.*, 1933. *In German.*—A goniometric study of the vicinal faces in the Zone [001]. Two groups are discerned—one corresponding to considerable stability and low indices; another in which vicinal surfaces appear completely or partially.
F. I. G. R.

908. Space Group of Tourmaline. W. H. Barnes and A. V. Wendling. *Roy. Soc. Canada, Trans.* 27. *pp.* 169–174, *May*, 1933.—This property is definitely established as C^1_{3v}. F. I. G. R.

909. Structure of Potassium Osmyl Chloride. J. L. Hoard and J. D. Grenko. *Zeits. f. Krist.* 87. *pp.* 100–109, *Jan.*, 1934. *In English.*—Potassium osmyl chloride, $K_2OsO_2Cl_4$, is face-centred tetragonal, *a* 9·90, *c* 8·75 Å, with 2 mols. in the unit cell, space group $D^{17}_{4h}-I4/mmm$. The structure is ionic with a fluorite-like grouping in which $2K'$ and $[OsO_2Cl_4]''$ are situated as F'_2 and $Ca^{\cdot\cdot}$ respectively; the $[OsO_2Cl_4]''$ ion, symmetry D_{4h}, is octahedral with Os at the centre and Os-Cl = 2·28, Os-O = 1·85, Cl-Cl = 3·22 and O-Cl = 2·94 Å. C. A. S.

910. Structure of Cadmium Hydroxychloride. J. L. Hoard and J. D. Grenko. *Zeits. f. Krist.* 87. *pp.* 110–119, *Jan.*, 1934. *In English.*—Cadmium hydroxychloride, Cd(OH)Cl, is hexagonal, *a* 3·66, *c* 10·27 Å, with 2 mols. in the unit cell, space group C^4_{6v} (*C6mc*). Each $Cd^{\cdot\cdot}$ is surrounded octahedrally by $3Cl'$ and $3(OH)'$, each of which is shared among $3Cd^{\cdot\cdot}$, the whole forming neutral layers parallel to the basal plane of composition Cd(OH)Cl. C. A. S.

911. Structure of Calcium Boride, CaB_6. L. Pauling and S. Weinbaum. *Zeits. f. Krist.* 87. *pp.* 181–184, *Jan.*, 1934. *In English.*—Verifying the results of v. Stackelberg and Neumann [see Abstract 1292 (1933)], the unit of structure of the cubic crystal CaB_6 is shown to have $a_0 = 4{\cdot}145 \pm 0{\cdot}005$ Å and to contain CA at $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, 6 B at $\pm\ 0 0 u$ ↷ The accurately-determined value of the parameter, $u = 0{\cdot}293 \pm 0{\cdot}001$, makes each boron atom equidistant from five others, the boron-boron separation being 1·716 Å. AUTHORS.

912. Structure of Hydrargillite $Al(OH)_3$. Helen D. Megaw. *Zeits. f. Krist.* 87. *pp.* 185–204, *Feb.*, 1934. *In English.*—The substance is monoclinic. The cell dimensions are $a = 8{\cdot}6236 \pm 0{\cdot}0007$ Å, $b = 5{\cdot}06021 \pm 0{\cdot}0006$ Å, $c = 9{\cdot}699 \pm 0{\cdot}004$ Å. $\beta = 85°26' \pm 5'$. There are eight molecules in the unit cell, and the space group is $C^5_{2h} - P2_{1/n}$. The structure is a layer lattice. The thermal expansion is discussed in detail.
F. I. G. R.

913. Structure of Silver Sulphate Tetrammoniate. R. B. Corey and R. W. G. Wyckoff. *Zeits. f. Krist.* 87. *pp.* 264–274, *Feb.*, 1934. *In English.*—Silver sulphate tetrammoniate, $Ag_2SO_4,4NH_3$, is tetragonal, *a* 8·44, *c* 6·35 Å; 2 mols. in the unit cell, space group V^4_4. The SO_4'' form tetrahedral groups, the $[Ag(NH_3)_2]^+$ ions are linear, and the two groups combined into layers; the Ag are at 0 1/2 1/2, 1/2 0 $\overline{1/2}$, 1/2 0 0 and 0 1/2 1; the S at 0 0 0 and 1/2 1/2 1/2; S – O = 1·65, Ag – N = 1·90 Å. C. A. S.

914. Crystal Hydrates. Part I. Structure of Magnesium Chloride- and Magnesium Bromide-Hexahydrates. K. R. Andress and J. Gundermann. *Zeits. f. Krist.* 87. *pp.* 345–369, *March*, 1934.—$Mg(H_2O)_6Cl_2$ and $Mg(H_2O)_6Br_2$ are monoclinic, with 2 molecules in the unit cell, and respectively *a* 9·90, *b* 7·15, *c* 6·10; *β* 94° and *a* 10·25, *b*

7·40, *c* 6·30, β 93° 30′, space group $C_{2h}^3 - C2/m$. The lattice may also be described as pseudorhombohedral, the unit cell having *a* 6·10 or 6·30, and two angles, α_1, α_2 88 – 88·5° and one α_3 72°, with one molecule therein. The $6H_2O$ are arranged octahedrally around a Mg atom, each such group is surrounded by 8 halogen ions, six in the same plane with the Mg, of which four are distant therefrom $4{\cdot}7_5$ and two $4{\cdot}8_5$ Å, and two vertically above and below the Mg and distant $4{\cdot}1_5$ Å; these two last are the two in direct connection with that Mg atom. The difference between the structure of the hexahydrates and that of the hexammoniates is due to the special dipole character of the H_2O molecule. C. A. S.

915. Structure of Thallic Dimethyl Halides. H. M. Powell and Dorothy M. Crowfoot. *Zeits. f. Krist.* 87. *pp.* 370–378, *March*, 1934. *In English.*—$TlMe_2Cl$, d_4^{25} 3·445, $TlMe_2Br$, d_4^{20}, and $TlMe_2I$ d_4^{25} 3·009, are tetragonal, $a : c = 1{\cdot}3291$, 1·3078 and ? respectively; of $TlMe_2Br$ $n_\omega = 1{\cdot}808$, $n_\epsilon = 1{\cdot}785$. X-Ray investigation shows the unit cell to be body-centred tetragonal, *a* 4·29, 4·47, 4·78, *c* 14·01, 13·78, 13·43 Å respectively, and containing two molecules; space group $D_{4h}^{17} - I\,4/mmm$. 2 Tl are at 000 and 1/2 1/2 1/2, two halogens at 1/2 1/2 0, and 0 0 1/2, and 4C at ± (00*z*), ± (1/2 1/2 1/2 + *z*), *z* for the iodide being approximately 0·15. C. A. S.

916. Structure of Anhydrous Zinc Sulphate. K. Schiff. *Zeits. f. Krist.* 87. *pp.* 379–386, *March*, 1934.—$ZnSO_4$ is rhombic, *a* $8{\cdot}58_1$, *b* $6{\cdot}73_7$, *c* 4·76, with 4 molecules in the unit cell. C. A. S.

917. Structures and Expansion Anomalies of MnO, MnS, FeO, Fe_3O_4 Between 100° K and 200° K. B. S. Ellefson and N. W. Taylor. *J. Chem. Phys.* 2. *pp.* 58–64, *Feb.*, 1934.—(1) Determinations have been made of structure type and lattice constants of MnO, MnS, FeO and Fe_3O_4 at temperatures near those at which these substances show specific heat anomalies. (2) No major structure changes were apparent in the X-ray patterns. All structures are cubic at all investigated temperatures. Lattice constant data indicate similarity in the abnormal expansion behaviour of MnS and FeO and of MnO and Fe_3O_4. The specific heat and expansion anomalies are probably due to electron transitions within certain atoms in the crystal lattice and may be analogous to the behaviour of metallic iron at 765° C, or of quartz at 575° C. AUTHORS.

918. Structure of $CaSO_4.4CO(NH_2)_2$. S. B. Hendricks. *J. Phys. Chem.* 37. *pp.* 1109–1122, *Dec.*, 1933.—Optical properties are used as a guide to the crystal structure of $CaSO_4.4CO(NH_2)_2$, which is partially determined from rotating crystal and Weissenberg photographs. The structure is based on an approximately face-centred triclinic lattice, the space group being P1 or P$\bar{1}$. The lattice dimensions are; $a = 14{\cdot}74$ Å, $b = 14{\cdot}95$ Å, $c = 6{\cdot}47$ Å. The interaxial angles are $\alpha = 91°26'$ and $\gamma = 86°50'$. There are four molecules in the unit cell. The X-ray density is 1·820 and that determined by a suspension method is 1·8006. Crystallographic measurements are made. The refractive indices for the sodium D line at 25° C. are found to be; $\alpha = 1{\cdot}523 \pm 0{\cdot}002$, $\beta = 1{\cdot}583 \pm 0{\cdot}002$, $\gamma = 1{\cdot}615 \pm 0{\cdot}002$. The crystals are optically negative, $2V = 70{\cdot}0°$. J. T.

919. Influence of Temperature on Asterisms in Crystals. S. Dembicka. *Acta Physica Polonica*, 2. 3. *pp.* 285–290, 1933. *In French.*—Crystals of NaCl and Al deformed by pressures of 600–800 gm. and 2–5 kg./mm.^{2} respectively, on examination by X-rays show asterisms, the striæ thereof increasing in length with pressure. On heating, the asterisms disappear at approximately the temperature at which recrystallisation begins—about 600° and 500° respectively, but show no tendency to do so at a lower temperature. An asterism in gypsum, whether natural or produced by bending, is unaltered by heating to 130°, the temperature at which gypsum becomes amorphous. C. A. S.

920. Mosaic Crystals of Zinc. H. K. Schilling. *Physics,* 5. *pp.* 1–3, *Jan.,* 1934.—Optically mosaic crystals of zinc have been grown by the Czochralski-Gomperz method. Three types have been distinguished. During growth mosaic crystals frequently change from one type to another. The conditions of growth under which they were obtained are described briefly. As yet their genesis and their evolutions during growth cannot be controlled or predetermined. AUTHOR.

921. Modification of Crystal Faces of Solute by Foreign Substances in Solution. L. Royer. *Comptes Rendus,* 198. *pp.* 185–187, *Jan.* 8, 1934.—From the results of a series of experiments, information has been obtained concerning the factors which condition the mutual orientation (epitaxy) of crystals of different species. When addition of a substance (B) to the solution of a crystalline compound (A) modifies the faces of the crystals which separate, well-defined structural relationships exist between the two substances. When a pure solution of A gives crystals free from the face (*pqr*), it is necessary, for this face to appear, that B is soluble in the solution of A; that no chemical reaction is possible between A and B; that A and B have different symmetries or modes of structure; that the lattice of crystal B possesses a plane $(p^1q^1r^1)$ which has a simple or multiple lattice almost identical in form and dimensions with a simple or multiple lattice of the plane (*pqr*) of A; that the ions of crystal B in the plane $(p^1q^1r^1)$ are of the same sign as those of A in the plane (*pqr*); probably that the modes of linkage of the elements of the crystal are identical in A and B. T. H. P.

922. X-Ray Method for Distinguishing between Certain Space Groups in the Hexagonal System. W. H. Barnes and A. V. Wendling. *Roy. Soc. Canada, Trans.* 27. *pp.* 133–140, *May,* 1933.—Of the nine pairs of space-groups considered, the Laue method allows a correct choice to be made, except in two cases. The final selection is achieved without reference to the relative positions of the diffracting centres in the unit cell. F. I. G. R.

923. Focalisation of Diffused X-Rays by Plane Crystalline Plates. (Miss) Y. Cauchois. *Comptes Rendus,* 198. *pp.* 76–78, *Jan.* 3, 1934.—An alternative method, using a circular slit or knife-edge, is worked out, whereby the result previously described is deduced. [See Abstract 2462 (1933).] C. A. S.

924. Focalisation Methods in Crystal Powder Analysis. H. Hulubei. *Comptes Rendus,* 198. *pp.* 79–80, *Jan.* 3, 1934.—The illumination of a crystalline powder or a liquid by a hollow conical beam of X-rays is treated mathematically. C. A. S.

See also Abstracts 879, 976, 1079, 1080, 1084, 1095, 1096, 1102, 1147, 1148, 1165, 1283, 1305, 1309, 1325, 1327, 1328, 1329, 1336, 1341, 1342, 1343.

DENSITY.

925. Density and Viscosity of Titanium Tetrachloride. T. Sagawa. *Tohoku Univ., Sci. Reports,* 22. *pp.* 959–971, *Dec.,* 1933. *Report No.* 314 *from the Research Inst. for Iron, Steel and other Metals.*

In English.—The density of titanium tetrachloride $TiCl_4$, has been determined by the dilatometric method at temperatures ranging from − 18·10° to 109·60°. In the experiment care has been taken to get the chloride as pure as possible and in the calculation of the density the vaporisation of the chloride at each temperature was taken into account. Using the same sample, the viscosity of the chloride also has been determined at 20° and 25°. AUTHOR.

926. Densities of Molten Inorganic Nitrate Mixtures. K. Laybourn and W. M. Madgin. *Chem. Soc., J. pp.* 1–7, *Jan.*, 1934.—Densities of the nitrates of K and Na, mixtures of the nitrates of K and Na, K and Pb, Na and Pb, K and Sr, K and Ba, and of K, Sr and Ba, were determined over a temperature range of about 150° above the freezing point. These systems have all previously been examined by the authors in other ways. The method of the density determinations was similar to that of Matuyama, and employed a pyrex dilatometer observed *in situ* suspended in a furnace. In all cases density varies linearly with temperature, the departure from the straight line never exceeding ± 0·001 gm./ml. The differences from Jaeger's results for KNO_3 and $NaNO_3$ do not exceed 0·002 gm./ml., although Jaeger's freezing points are 1° or 2° C. lower. Only in the system $KNO_3 - NaNO_3$ could a full range of composition be examined, and the deviation from the straight line of the isothermal specific volume-composition curves is slight and decreases with decreasing temperature, the curves being convex towards the composition axis. The system $KNO_3 - Pb(NO_3)_2$ behaves similarly, while the system $NaNO_3 - PbNO_3$ gives a straight line. The systems $KNO_3 - SrNO_3$ and $KNO_3 - Ba(NO_3)_2$ differ slightly from the straight line in the opposite sense. The results are applied to the method of construction previously used by the authors in deducing liquidus isothermal diagrams. P. H. B.

927. Temperature Variation of Orthobaric Density of Unassociated Liquids. A. Ferguson and J. T. Miller. *Phys. Soc., Proc.* 46. *pp.* 140–147, *March* 1, 1934.—A formula connecting the orthobaric density of a liquid and its temperature is developed in the form $\rho = 2\rho_c [A\ (1 - m)^{0 \cdot 3} + (1 - \frac{1}{2}m)]$, where m is reduced temperature and A is a constant which varies slightly from liquid to liquid, and may be taken to have a mean value 0·91. The formula is a long-range one, and has been tested for thirty pure organic substances. It has been applied to the evaluation of expansion coefficients, and to show the manner in which free and total molecular surface energies vary with temperature. AUTHORS.

See also Abstract 1151.

DIFFUSION AND OSMOSIS.

928. Diffusion Through a Membrane. C. Barnes. *Physics,* 5. *pp.* 4–8, *Jan.*, 1934.—An exact solution is obtained for the problem of diffusion through a membrane separating two stirred solutions of different concentrations. For a diffusion cell in which the two liquid containers have the same volume and for which the ratio λ ("effective" volume of membrane : volume of liquid) is small compared with unity, the solution gives explicit expressions for the concentrations at any time in terms of the initial distribution of concentration in the membrane. Two cases are treated : (1) zero initial concentration in the membrane and in one of the liquids ; (2) an initial linear concentration gradient connecting the concentrations in the two containers. The usual assumption of a linear gradient across the membrane during the whole course of diffusion will not lead to an appreciable error in a determination of a diffusion constant unless λ exceeds 0·1 or the time of diffusion is much shorter than in the usual practice. Since λ is about 0·02 in the usual type of diffusion cell the use of the simple expression based on a linear gradient cannot be in error. If, however, the preliminary treatment of the membrane fails to yield an initial linear gradient in it, an appreciable error will be made even with λ less than 0·02. AUTHOR.

929. Accelerated and Retarded Diffusion in Aqueous Solution. J. W. McBain and C. R. Dawson. *Am. Chem. Soc., J.* 56. *pp.* 52–56, *Jan.,* 1934.—The general equation for the diffusion, D_H, of the H^+ ion in a mixture of HCl and KCl is $D_H G_H = RTU_H(G_H - QC_H)$, with similar equations for D_K and D_{Cl} the diffusion coefficients of K^+ and Cl^-, where $Q = (G_H U_H + G_K U_K - G_{Cl} U_{Cl})/(C_H U_H + C_K U_K + C_{Cl} U_{Cl})$. G_H is the difference in concentration of H ion on either side of the diffusion membrane (sintered glass), U_H the mobility of the hydrogen ion, and R and T have their usual meanings. The thus calculated and experimental values have been compared for values of G_{Cl} 0·0190 – 0·597, the HCl diffusing with, through, and against the KCl. Agreement is fair but collision effects of diffusing columns affect the higher concentrations. The diffusion coefficient of glycine was determined for (*a*) glycine diffusing into water of pH 6·1 (the isoelectric point of glycine), (*b*) glycine + HCl into HCl, aq. of the same pH, (*c*) glycine + HCl into water, and (*d*) *N*/10-glycine and HCl,aq. of varying concentration diffusing into each other. In all cases there was marked decrease in the coefficient with increased coefficient, explicable by collision with the molecules of the diffusing column. In (*d*) owing to chemical action the diffusion coeefficients are very much higher than normal, the Cl^- and glycine moving up to 5 and 3 times their normal rates respectively. C. A. S.

930. Osmotic Behaviour of Alkali Halides. G. Damköhler and J. Weinzierl. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 71–86, *Dec.,* 1933.—The method previously described for the cryoscopic determination of freezing-point lowering [see Abstract 1701 (1931)] has been improved and applied to measurements with solutions of lithium, sodium, potassium and cæsium bromides. For accurate interferometric measurement of the concentration of salt solutions with the Haber-Loewe interferometer it has been found necessary to enclose the apparatus in a thermostat. The molecular depression δ passes through a minimum at about 0·1 *M* for LiBr, and at about 0·5 *M* for NaBr. δ is practically the same for KCl and KBr. For lithium and sodium salts δ increases in the order chloride, bromide, iodide, but for cæsium the order is reversed; for the chlorides, bromides and iodides it increases on passing from cæsium to lithium, whereas for the fluorides it decreases. For KF, RbF and CsF δ is smaller than for the corresponding chlorides. H. F. G.

931. Origin and Calculation of Osmotic Pressure. K. Fredenhagen. *Zeits. f. Physik,* 87. 1–2. *pp.* 62–77, *Dec.* 13, 1933.—The author refers to the contradictory accounts of the origin of osmotic pressure given in various text books and gives an account of his own theory. The objection that was raised to this theory that Planck had proved the correctness of van't Hoff's "excess pressure" theory of osmotic pressure by thermodynamics is rejected by the author who quotes communications from Planck which clearly express the view that thermodynamics gives no information about the molecular processes and actions of osmotic pressure, and that the author's "defect pressure" theory (*Unterdrucktheorie*) is certainly permissible from the point of view of thermodynamics and preferable to the "kinetic" theory of osmotic pressure, which has definite weaknesses. The author defines osmotic pressure and gives a critical account of various theories that have been proposed. He develops his own theory and discusses the results which accrue from it and the conditions in which it is applicable. H. L. B.

See also Abstracts 861, 887, 888, 889, 890, 946, 986, 1209.

ELASTICITY AND PLASTICITY.

932. Elastic Heredity. V. A. Kostitzin. *Comptes Rendus*, 198. *pp.* 47–49, *Jan.* 3, *and pp.* 240–242, *Jan.* 15, 1934.—The two relations, deduced by both Boltzmann and Volterra, giving as a function of time the deformation of an elastic body previously subjected to a varying load, seem to be contradicted by recent measurements of Pichot on samples of stone. It is possible, however, to deduce from the two equations a more general one, with which the measurements do agree. For larger loads the original equations would probably have been verified. Beginning with the dynamic form of Boltzmann's equation of elastic heredity an integro-differential equation, more suited to comparison with experiment, is developed, but found again to disagree with experiment. A non-linear form of equation such as Volterra's may be more suitable. J. P. A.

933. Electrical Analogy in the Study of Torsion. M. Stone. *Univ. Pittsburgh, Bull.* 30. *pp.* 265–274, *Nov.* 15, 1933.—A general mathematical analogy is established between the flow of electricity in a plate and the torsion of a prism. An infinite number of special cases may be obtained, each corresponding to a problem in torsion. J. P. A.

934. Isothermals of Nitrogen. J. Otto, A. Michels and H. Wouters. *Phys. Zeits.* 35. *pp.* 97–100, *Feb.* 1, 1934.—The isothermals of nitrogen are redetermined between 0° and 150° C., in steps of about 25° C, and from 45 to 400 atmospheres. The values of pv thus obtained are tabulated, and fitted to formulæ which give pv as a series of powers of (*a*) the density d, up to terms with d^8, and of (*b*) the pressure up to terms involving p^8. Tables faciltating comparison with previous determinations are given. It is found that the work of the Reichsanstalt agrees best, and that of Smith and Taylor least satisfactorily, with the present results. J. P. A.

935. Stress-Strain Relation in Textile Fibres. R. L. Steinberger. *Physics*, 5. *pp.* 53–60, *Feb.*, 1934.—Stress-strain relations for eight common textile fibres are given (four rayons, silk, wool, cotton and ramie) under known humidity conditions. The method has two novel features: (1) in each experiment the section area was determined on the specific fibre under test, (2) the elongations were made in steps, with a relaxation interval of 30 seconds between stress observations, rather than at a constant rate which is the usual practice. The rayons exhibit an accurately linear initial curve from which Young's modulus can be determined, followed by a yield point and a long region of plastic flow. The curves for cotton and ramie are linear with no plastic yield in the range examined. In silk and wool there is no proportionality between stress and strain. Cellulose acetate exhibits the phenomena of "cold working" and marked increase of total and elastic energy with falling relative humidity. The application of Maxwell's relaxation equation is examined. AUTHOR.

936. Demonstration of Stationary and Travelling Waves. W. Meyer zur Capellen. *Zeits. f. Instrumentenk.* 54. *pp.* 12–15, *Jan.*, 1934.—With no damping (1) stationary waves can be illustrated by the projection on to a plane parallel to the axis of motion of a line representing a cosine curve, and (2) travelling waves illustrated from a motion of rotation. With damped motion similar methods can be employed. The author establishes differential equations for the case of damped motion and for the projections to illustrate these types of waves. Diagrams illustrate the relations obtained. R. S. R.

937. Distribution of Deformation in Strained Test-Pieces. A. Portevin and M. Cymboliste. *Comptes Rendus*, 198. *pp.* 146–148, *Jan.* 8, 1934.—If a polished metal surface is coatedwith a brittle, adhesive varnish and the metal strained, the varnish cracks in lines perpendicular to the direction of maximum extension. Subsequent inspection of the crack system yields important information regarding the deformation. Illustrations are given. J. P. A.

938. Measurement of Impact Stresses in Concrete. G. Grime. *Phys. Soc., Proc.* 46. *pp.* 196–202; *Disc.*, 203–204, *March* 1, 1934.—A quartz piezoelectric gauge, used with a kathode-ray oscillograph for recording, has been developed to measure impact stresses in concrete. It is being employed to study the stresses in driven reinforced-concrete piles. Records illustrating the character of these stresses are given. AUTHOR.

See also Abstracts 880, 971, 1245, 1246, 1254, 1314.

GRAVITATION.

939. Gravity Measurements at Sea, 1923-1932. F. A. V. Meinesz. *Gerlands Beitr. z. Geophys. Supplementband,* 2. *pp.* 153–212, 1933.—The aims of the various expeditions by submarine during the period 1923–1932 were to obtain additional data about the figure of the earth, more especially about its equatorial cross-section, and to ascertain the distribution of mass in the earth's crust in hitherto unexplored regions. Gravity measurements at sea afford some compensation for the additional mechanical difficulties of observation as compared with measurements on land; the disturbing influences due to topography are very considerably reduced, most of the observations being made in regions where the sea-bed was over 4000 metres below the observer. The apparatus used has been described elsewhere ("Theory and Practice of Pendulum Observations at Sea," F. A. V. Meinesz. Publ. Netherlands Geodetic Commission, 1929). In the present article, the general theory of the applicability of gravity observations to the determination of the figure of the earth is outlined, with detailed consideration of the problem of isostatic compensation. The programme of observations covered voyages from Holland *via* Suez to Java in 1923, to Alexandria in 1925, and *via* Panama to Java in 1926, thus completing a circuit of the globe. In 1928 to 1932 supplementary observations were made at sea in the West Indies and in the East Indies. All anomalies were isostatically compensated by the U.S. Coast and Geodetic Survey personnel, the compensation depth being taken as 113·7 km. The results of the observations confirmed the hypothesis of isostasy. Extensive positive anomalies were revealed, *e.g.*, in the Atlantic and Pacific Oceans and in the East and West Indies, of the order of 100 mgal, but only in one place, in the Indian Ocean, an extensive series of negative anomalies, much less in magnitude on the average than the positive series. Also, there was a general increase in the anomaly in the positive sense in passing into deeper water. The deviations from isostasy do not conform to the hypothesis that at its equator, the geoid is elliptical, but are more probably attributable to tectonic activity in the earth's crust. The relationship between the anomalies of the Dutch East Indies and adjoining oceans and the seismic, volcanic and tectonic data of these regions is given careful analysis by the author, who concludes that the principal tectonic feature is located in the deeper layers of the crust and consists of a buckling of the crust towards the interior along a line running through the whole Archipelago. E. L. J.

940. Eötvös Gravity Balance in Fluctuating Gravitational Fields. A. O. Rankine. *Phys. Soc., Proc.* 46. *pp.* 137–139; *Disc.*, 139, *March* 1, 1934.—In this note attention is directed to the semi-diurnal variation of gravity at a point on the earth's surface, due to lunar attraction and recently measured by Loomis [see Abstract 2519 (1931)]. It is shown that this temporal variation of *g* is much larger than the spatial differences measured by the Eötvös gravity balance, but that it produces no effect on the balance. This constitutes an experimental proof of the power of the Eötvös instrument to discriminate between space and time changes of terrestrial gravitation. AUTHOR.

941. Stroboscopic Jet Method for Determining "g." E. Tyler. *Phil. Mag.* 17. *pp.* 282–291, *Feb.*, 1934.—A method is described in which a liquid jet, projected horizontally, is resolved into drops at a definite frequency by coupling it to a vibrator consisting of either (*a*) a buzzer or electrically maintained fork, or (*b*) a valve-controlled loud-speaker unit. Employing a neon lamp as a source of illuminant for the jet, and illuminated intermittently at the same frequency as that of drop formation, stroboscopic vision of the detached drops is effected. Under such conditions the apparent stationary drops register their own displacement-time curves, and measurement of such trajectories with a travelling microscope together with a knowledge of the frequency of drop formation enables "g" to be evaluated. Stroboscopic and spark photographs are also included, from which "g" is also computed. AUTHOR.

See also Abstract 953.

HYDRODYNAMICS AND AERODYNAMICS.

942. Plate in Rotation in a Fluid Stream. A. Asfazadour. *Comptes Rendus*, 198. *pp.* 245–247, *Jan.* 15, 1934.—In continuation of work by Riabouchinsky [see Abstract 465 (1934)] the author has mapped the stream lines in the neighbourhood of a rotating plate immersed in a fluid stream. J. W. T. W.

943. Supersonic Blowing Machine with Large Coefficient of Speed. L. Santon. *Comptes Rendus*, 198. *pp.* 334–336, *Jan.* 22, 1934.—Details are given regarding a branched blowing machine used for air distribution in Paris. The air arrives at a pressure of 4 kg./cm.^{2} in a blast pipe of rectangular section whose two faces allow a study of the flow by the method of shadows. The two faces rest on wedges of a profile selected to give Mach waves and so a first measure of the speed. The most suitable dimensions of the apparatus are given. From these results it is possible to predict the necessary conditions to give a supersonic blowing machine by aspiration, which in many ways is preferable to one employing expansion, the forces required being less, the air motion stable, and the action independent of variations of the motor. R. S. R.

944. Stability of Heterogeneous Liquids. J. L. Synge. *Roy. Soc. Canada, Trans.* 27. *pp.* 1–18, *May,* 1933.—It is shown mathematically that the necessary and sufficient condition for the stability of the motion of rotation of a heterogeneous, incompressible, inviscid liquid about an axis is that $d\ (\rho k^2)/dr > 0$ throughout the liquid, where r is the distance from the axis, ρ the density and k the circulation at r. This reduces to Rayleigh's criterion for $\rho = \text{const.}$ The stability of a heterogeneous liquid under gravity and contained between two fixed horizontal planes is discussed. J. S. G. T.

945. Tendency of Vortex Filaments to Stand Normally to a Plane Surface. O. Nomoto, J. Sakagami and Y. Fujii. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 16–34, *Jan.,* 1934. *In English.*—The behaviour of vortices produced by rotating stirrers of different shapes and moving on axes inclined at various angles to the walls of the (rectangular section) vessel has been studied by photographing, through the sides of the vessel, the filament of air drawn in by the action of the stirrer. The filament tends to assume a position normal to a plane surface, and has a definite structure, sometimes becoming spiral. It is not reflected at the wall. "Wanderer-vortices" sometimes appear as a result of the square corners of the vessel. Both the main and wanderer vortices undergo cyclic changes; the filament is enlarged where it makes contact with the wall, and the enlarged portion expands and contracts rhythmically. H. F. G.

946. Laminar Diffusion Processes in a Viscous Fluid. W. Müller. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 395–408, *Dec.,* 1933. —A mathematical treatment of the laminar flow of a viscous fluid in which the velocity and pressure distributions are functions of time and a single space coordinate. The following cases are treated: (1) effusion of fluid through a plane slit, and (2) motion in a circular cylindrical vortex sheet. J. S. G. T.

947. Resistance of Impact on Water Surface. Part IV. Circular Plane. S. Watanabe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 477. *pp.* 118–135, *Dec.,* 1933. *In English.*—In previous papers [see Abstracts 2400 (1930) and 341 (1931)] the impact on a water surface of a cone and a wedge have been dealt with. A plane is the extreme case of both of these, and the phenomena during the early stages of impact of a circular plane (3 cm. dia.) are here investigated by the same method as was previously used. The oscillograms are reproduced and the results are set out in detail. The maximum resistance is reached in about 1×10^{-4} sec. after impact, and is given by $R_m = 0\cdot203 \times H^{1\cdot2} \sqrt{M} \times D$, where H cm. is the height of fall, M kg. the falling mass, and D cm. the diameter. P. H. B.

948. Generalised Green's Law on Wave Motion in a Canal of Variable Section. H. Arakawa. *Geophys. Mag., Tokyo,* 7. *pp.* 319–325, *Nov.,* 1933. *In English.*—From the generalised Green's law it is found that the amplitude of waves travelling up a canal becomes greater the gentler the slope of the bottom; the more gradual the variation of the breadth of the canal the greater the amplitude of the waves; the amplitude increases more rapidly in the case of short than of long waves; and, lastly, assuming small oscillations, the amplitude on a sloping shore depends on the slope of the bottom as well as on the width of the channel. W. A. R.

949. Illuminating Liquid Currents. U. Schmieschek. *Zeits. f. techn. Physik*, 14. 12. *pp.* 566–567, 1933.—Currents, whirls, etc., in the interior of a liquid rendered visible or amenable to photographic methods by suspending fine crystals of metallic silver in the liquid and applying lateral illumination. A method is given for preparing the silver crystals, which are very brilliant. A. D.

See also Abstracts 895, 977, 1040, 1208.

KINETIC THEORY OF MATTER.

950. Atomic Collisions. Part I. Production of Slow Atomic Rays by Neutralisation and their Measurement by Means of a Thermopile. O. Beeck. *Ann. d. Physik*, 19. 2. *pp.* 121–128, *Jan.*, 1934.—A method is described which makes it possible to produce monochromatic atomic rays of considerable intensity and to measure them absolutely at even relatively low velocities (equivalent to a velocity of a few hundred ion-volts) by means of a specially designed thermopile. Details are given of the manner in which the ions are produced, rendered homogeneous, neutralised and again made homogeneous. [See following Abstract.] H. L. B.

951. Atomic Collisions. Part II. Ionisation of Argon by means of Neutral Argon. O. Beeck and H. Wayland. *Ann. d. Physik*, 19. 2. *pp.* 129–142, *Jan.*, 1934.—The method described in Part I of these researches [see preceding Abstract] for producing slow monochromatic atomic rays is applied to measuring the ionisation function N (that is, the number of ionising collisions per atom per cm. path at a pressure of 1 mm. of Hg and at 0° C; numerically equal to the ionising cross-section). The velocity of the A atoms was between 350 and 650 ion-volts. The efficiency amounts to about 4 times that which occurs in collisions between K^+ and A, and surpasses still further the efficiency that occurs in the collisions of A^+-ions with A. The results are discussed in the light of Weizel and Beeck's theory of ionic collisions: reference is made to their bearing on discharge phenomena. H. L. B.

See also Abstracts 981, 992, 1209, 1211.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 1325.

MATHEMATICAL METHODS THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

952. Theory of Durability. S. Watanabe. *Geophys. Mag., Tokyo*, 7. *pp.* 307–317, *Nov.*, 1933. *In English.*—This paper is mainly mathematical. After showing how a "state" may be defined the author gives an expression for the general form of the law of duration. From the law he obtains other expressions giving the probability that a state which has continued for a certain time will, or will not, continue throughout another definite interval, or that a state will be renewed again after such an interval or intervals. Examples of the law of durability are then discussed and also the application of the law, by a consideration of the problem of periodicity of the meteorological elements. With the atmospheric temperature as element the curve deduced from theory is in good agreement with the actual values. A. E. M. G.

953. Material Mass, Electrostatic Charge and Attraction Constants. I. N. Longinescu. *Soc. Romåne Fiz., Bul.* 35. *pp.* 161–167, *Nov.-Dec.*, 1933. *In French.*—The author criticises the existing definitions of unit mass and unit electric charge and proposes as new fundamental units the mass of a neutron and the charge of an electron. To obtain practical units, it is proposed to multiply each of the fundamental units by Avogadro's number, and this restores the gramme and gives for electric charge a unit of 96,500 coulombs. The ratio of the Newtonian to the Coulombian constants is computed in this system to equal $1 \cdot 3 \times 10^{36}$, a number which is independent of the units of length and force. W. S. S.

See also Abstract 1136.

MECHANICS, CLASSICAL.

954. Mechanical Equilibrium of Rotating Bodies. L. Couffignal. *Comptes Rendus,* 198. *pp.* 336–338, *Jan.* 22, 1934.—Numerous methods relating to the mechanical equilibrium are based on measurements of certain vibratory motions of the rotor. The nature of the necessary measurements is set out for static equilibrium with and without friction, dynamic equilibrium with the angular velocity of rotation of the rotor in resonance with the vibrator or having any speed, and for complete equilibrium. Finally, the principle of an apparatus to be used for these measurements is outlined. R. S. R.

955. Frequencies. T. Pöschl. *Zeits. f. techn. Physik,* 14. 12. *pp.* 565–566, 1933.—Novel application of Land's circle, known in technical mechanics, for the ascertainment of the frequencies of systems of two dimensions as also the principal values and principal axes of any bi-dimensional tensor. A. D.

See also Abstracts 997, 998, 1000.

MECHANICS, QUANTUM.

956. Connection between Semi-Vectors and Spinors and the Reduction of Dirac's Equation for Semi-Vectors. V. Bargmann. *Helv. Phys. Acta,* 7. 1. *pp.* 57–82, 1934. *In German.*—This paper is a purely mathematical one and consists of the theory of the connection between the semi-vectors of Einstein and Mayer [see Abstract 2227 (1933)] and spinors. The form of the Dirac equation expressed in spinors, is obtained from the semi-vector form. G. C. McV.

957. New Method of Calculating the Mean Value of $1/r^s$ for Keplerian Systems in Quantum Mechanics. J. H. van Vleck. *Roy. Soc., Proc.* 143. *pp.* 679–681, *Feb.,* 1 1934.—The diagonal matrix elements of a negative power of the radius r in an inverse square quantum system can be calculated by an application of Dirac's q- number algebra. A terminating Fourier series is obtained, in which the constant term is the required mean value. The more complex expressions for the diagonal elements of $1/r^5$ and $1/r^6$, required in calculations on atomic spectral terms, are also given. N. M. B.

958. Quantum Mechanics of Photons. A. Proca. *Comptes Rendus,* 198. *pp.* 54–56, *Jan.* 3, 1934.—The difficulty of establishing a quantum mechanics of photons in configuration space is traced, in part, to the fact that the Maxwell energy density is only a first approximation. A quantum treatment, analogous to the relativistic Schrödinger mechanics, is examined, but a proposed modification of the energy density expression is unable to take polarisation into account. N. M. B.

959. Operators and the Derivation of Mean Values in Wave Mechanics. E. Madelung. *Zeits. f. Physik,* 87. 5–6. *pp.* 361–363, *Jan.* 15, 1934.—It is shown that the operational methods of wave mechanics can be applied to derive mean values of certain functions. J. S. G. T.

960. Quantum Mechanics of the Anharmonic Oscillator. P. M. Davidson. *Zeits. f. Physik,* 87. 5–6. *pp.* 364–369, *Jan.* 15, 1934.—Attention is directed to an error in Pöschl and Teller's criticism [see Abstract 3360 (1933)] of work by Morse [see Abstract 63 (1930)], and the quantisation of the motion characterised by the potential functions of Pöschl and Teller is effected in accordance with the principles of the older quantum theory. J. S. G. T.

961. General Relativistic Quantum Mechanics. Part I. Geodetic Lines and Quantum Mechanics. H. Jehle. *Zeits. f. Physik,* 87. 5–6. *pp.* 370–374, *Jan.* 15, 1934.—A quantum theory embracing both electrical elementary particles and cosmological problems is developed. J. S. G. T.

962. Establishment of Schrödinger's Equation. R. Dugas. *Comptes Rendus,* 197. *pp.* 1386–1388, *Dec.* 4, 1933.—It is shown that whereas in expositions of wave mechanics it is usual to introduce Schrödinger's equation, starting from the dynamics of a material point, it is possible to arrive at a more general result for the relativistic form of the equation by consideration of Jacobi's equation. From the analytical point of view, the new mechanics involve merely the introduction of a factor of the form $(hi/2\pi)\Delta V$ into Jacobi's equation. H. F. G.

963. Ordering of Wave Functions and Eigenenergies to the Individual Electrons of an Atom. T. Koopmans. *Physica,* 1. 2. *pp.* 104–113, *Dec.,* 1933. *In German.*—By an analysis of the Hamiltonian function for n electrons in the field of a central nucleus, it is shown that particular wave functions and eigenvalues can be ordered uniquely to the individual electrons, the eigenvalues being equal, save for a small correction, to the energies required to remove the respective electrons (X-ray terms). This result applies only in cases where the wave function can significantly be expressed as a single Slater determinant. The equations obtained for the wave functions associated with the electrons agree with those given by Fock using his approximation method. W. S. S.

964. Function Theory in Wave Mechanics of Hydrogen Atom. A. Byk. *Ann. d. Physik,* 19. 1. *pp.* 9–36, *Jan.,* 1934.—The paper is a purely mathematical one and contains a detailed treatment of the solution of the wave equation for the hydrogen atom by the method of contour integrals in the complex plane. G. C. McV.

965. Calculations of Atomic Wave Functions. Part II. Results for K^+ and Cs^+. D. R. Hartree. *Roy. Soc., Proc.* 143. *pp.* 506–517, *Feb.,* 1934.—In continuation of the plan outlined in a previous paper [see Abstract 3936 (1933)] for making generally available the results of calculations of atomic wave functions by the method of the "self-consistent field," results for K^+ and Cs^+ are here presented, together with some additional results for Cu^+. AUTHOR.

966. Statistics of Polyatomic Gases. K. Széll. *Zeits. f. Physik,* 86. 11–12. *pp.* 810–817, *Dec.* 6, 1933.—The Fermi-Dirac and the Bose-Einstein statistics are applied to the translational and rotational motion of those polyatomic gases with rigid molecules, in which (*a*) two of the three principal moments of inertia are equal to one another, and (*b*) all three principal moments of inertia are equal. With the help of Euler's summation formula the conditions under which the Fermi-Dirac or the Bose-Einstein statistics would prevail are calculated. The results indicate that the states of degeneracy that would lead to their introduction do not occur in polyatomic gases with rigid molecules. The author takes this opportunity of correcting a misprint in an earlier paper [see Abstract 3941 (1933)], which deals with the application of the above two types of statistics to the translational and rotational motion of diatomic molecules. H. L. B.

See also Abstracts 876, 969, 1111, 1138, 1139, 1173, 1242, 1244.

RELATIVITY AND ETHER.

967. Ether-Drift Experiment and Determination of the Absolute Motion of the Earth. D. C. Miller. *Nature*, 133. *pp*. 162–164, *Feb*. 3, 1934. *Paper read before the British Assoc., Leicester, Sept.*, 1933.—A general account is given of the Michelson interferometer observations by which the author claims to have determined the velocity of the earth in space relative to the ether. This velocity is directed almost in the same line, but in the opposite direction, to that found by determinations of the velocity of the solar system relative to the stars. The magnitude and direction of the observed effect varies in the manner required by the assumption that the earth is moving through a fixed ether. The magnitude of the velocity observed is, however, only one-twentieth of that which should be found on this hypothesis. [See following Abstract.] G. C. McV.

968. Velocity of the Earth Measured by Purely Terrestrial Experiments. E. Carvallo. *Comptes Rendus*, 198. *pp*. 247–249, *Jan*. 15, 1934.—An alternative experimental method, not making use of the Michelson interferometer, is described which, it is claimed, gives a measure of the absolute velocity of the earth through the ether. The calculated velocity found agrees fairly well with that of Miller [see preceding Abstract], but the direction of motion is not in good agreement. G. C. McV.

969. De Broglie Waves in an Arbitrary Gravitational and Electromagnetic Field. J. Géhéniau. *Comptes Rendus*, 197. *pp*. 1305–1307, *Nov*. 27, 1933.—Shows that the wave mechanics of a mass point carrying charge is in complete harmony with relativity dynamics. W. S. S.

970. Unified Field Theory. Part II. Gravitation. D. Meksyn. *Phil. Mag*. 17. *pp*. 476–482, *Feb*., 1934. *Supplement*.—An eight-dimensional space-time whose metric satisfies Einstein's law of gravitation $G_{\mu\nu}=0$ describes the gravitational field due to two particles. The law of motion of the two particles is a geodesic of its eight-dimensional space. The general result is analogous to the classical case. Two particles m, M moving under the influence of their gravitational fields are equivalent to a particle of mass $m+M$, located in the centre of gravity and moving with a uniform rectilinear velocity, and a particle of reduced mass $mM/(m+M)$ moving in a gravitational field due to mass $m+M$. Centre of gravity regains the same importance in our case as in the classical dynamics. [For Part I see Abstract 490 (1934).] AUTHOR.

See also Abstracts 961, 993, 1317.

SOLUTION.

971. Concentration and Compressibility of Aqueous Solutions. R. E. Gibson. *Am. Chem. Soc., J*. 56. *pp*. 4–14, *Jan*., 1934.—The compressibility of aqueous solutions of eleven sulphates has been measured over the whole range of concentration up to pressures of 1000 bars. For sulphates not greatly hydrolysed, bulk compressions of solutions of the same motality are approximately the same. A deviation function A, giving the difference between the specific compression of pure water and water in a solution of motality m can be expressed as $A = am + 6m^{3/2}$. The influence of the solute on the constants a and b is discussed. The pressures at which very pure benzene freezes at definite temperatures between 20° and 30° have been measured, and the results can be expressed by the equation $P = 5 \cdot 18 \cdot 8 + 37 \cdot 4(t-20) + 0 \cdot 104(t-20)^2$, where P is the pressure in bars and t the temperature in °C. It is suggested that this equation should be used to establish a pressure scale between 500 and 1000 bars. F. J. W.

972. Solubility of Inorganic Compounds in Liquid Ammonia. Part II. M. Linhard and M. Stephan. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 87–102, *Dec.*, 1933.—The solubilities of 24 salts at 0° C. are recorded. The alkali chlorides, except sodium, are almost insoluble (0·1–0·3 %), whilst of the alkali iodides, all except sodium are more soluble than in water. For silver salts the order is reversed as compared with water, the solubility of the iodide being 84 %. The alkaline earth halides and lithium and magnesium salts are very sparingly soluble, with the exception of calcium iodide (3·85 %). The kations appear to undergo the greater solvation. Fajan's solubility rule is valid for the results obtained. [For Part I see Abstract 1760 (1933).] H. F. G.

973. Solubility of Hydrogen in Water at 0°, 50°, 75° and 100° C. and from 25 to 1000 Atmospheres Pressure. R. Wiebe and V. L. Gaddy. *Am. Chem. Soc., J.* 56. *pp.* 76–79, *Jan.*, 1934.—Continuing previous work [see Abstract 2239 (1933)], the solubility of hydrogen in water has been determined at 0°, 50°, 75° and 100° C. and from 25 to 1000 atmospheres pressure. The solubility shows a minimum within the experimental range similar to that of nitrogen. Existing data seem to show that minima are a general phenomenon that can be deduced from the known behaviour of mixtures and not necessarily dependent on specific properties of the solvent or solute. L. A. W.

974. Velocity of Solution of Electrolytic Zinc in Acids. M. Centnerszwer and M. Straumanis. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 421–430, *Jan.*, 1934.—The velocity of solution of chemically pure, electrolytic zinc in HCl and H_2SO_4 was investigated. The reaction was measured by the volume of hydrogen evolved. Pure, electrolytic zinc was found to dissolve more slowly than zinc which was not pure, but was dissolved at practically the same rate as the difficulty soluble alloy of zinc with 0·2 % cadmium. Zinc plates which were mechanically cleaned by grinding commenced to dissolve at the maximum velocity, but after a short period, the velocity decreased and the value reached was characteristic for both the metal and the acid. The velocity of solution of electrolytic zinc, in HCl up to $2N$ in concentration, could be expressed by the equation $dv/dt = K(C - C_0)$, where C_0 denoted the concentration of HCl at which solution of zinc commences, and C the concentration of the acid under investigation. Electrolytic zinc dissolved much more slowly in H_2SO_4 than in HCl of the same H-ion concentration. F. J. B.

975. Critical Solution Phenomena. M. Freed. *Roy. Soc. Canada, Trans.* 27. *pp.* 179–181, *May*, 1933.—The value 42·6° obtained by Rothmund (*Zeits. f. phys. Chem.* 26. *p.* 447, 1898) for the critical solution temperature of the system *n*-hexane-methyl alcohol is undoubtedly too high, Cornish's unpublished value, 32°, being probably not more than 2° too low. Owing to the difficulty of obtaining pure *n*-hexane and its high cost, the system cyclohexane-methyl alcohol is better suited for the determination of water in methyl alcohol. Hand's suggestion that the solubility relations in the ternary system acetic acid-benzene-water are appreciably affected by pressure [see Abstract 636 (1931)] is not confirmed. T. H. P.

SURFACE TENSION AND COHESION.

976. Experiments on Cohesion. Part V. H. Tertsch. *Zeits. f. Krist.* 87. *pp.* 326–341, *Feb.*, 1934.—For anhydrite, a regular sequence of cleavage capacity is found as follows: $(100) < (010) < (001)$. As regards the fine structure, it may be supposed that there is formation of surface nuclei with respect to (001), and consequent appearance of weak positions for these surfaces. [See also Abstract 2154 (1933).] F. I. G. R.

977. Effects Produced when Liquid Jets of Low Velocity Fall on a Barrier. J. H. Brinkworth. *Phys. Soc., Proc.* 44. *pp.* 225–226, *March* 1, 1932.—When a liquid jet falls on a barrier it takes up configurations somewhat like those theoretically possible for a hanging drop, *i.e.*, liquid under static equilibrium conditions. Such jets showing stationary vibrations are, in general, perfectly stable, and the changes in the contour of the jet can be studied by altering the position of the barrier. For certain very definite positions of the barrier the jets show maintained vibrations in horizontal planes, in other positions maintained vibrations along the axis of the jet can be obtained. Otto Maass [see Trans. Roy. Soc. Canada, Ser. 3, vol. 9, pp. 133–138, 1915] measured the wave-length on that part of a jet showing stationary waves where the radius is changing slowly and deduced a value 74·6 dynes/cm. for the surface tension of water at 12° C. AUTHOR.

978. Free Surface Energy of Liquids and Liquid Mixtures. Y. Morino. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 476. *pp.* 49–117, *Dec.*, 1933. *In English.*—The surface tension of benzene, carbon tetrachloride chlorobenzene, ethyl ether, ethyl acetate, methyl alcohol, ethyl alcohol, propyl alcohol, acetic acid, and binary mixtures of some normal liquids were measured between 20° C. and 170° C. by the capillary-rise method. The capillary was totally enclosed with an observed weight of the liquid in a special vessel of determined volume, which enabled the liquid density to be determined *in situ*. Katayama's formula $\mu = \gamma \{M/(d_l - d_g)\}^{2/3} = K(C - T)$ holds for these normal liquids, the average value of K being 2·210. It also holds for the binary mixtures for which from the relation between critical temperature and composition an expression for the constant C is deduced. An equation for the critical temperature of a binary mixture deduced by the application of van der Waals' equation was found to express the critical temperature of mixtures of common organic liquids. Equations connecting surface tension, etc., and composition put forward by Pawlow, Volkmann, Poisson and Worley are shown to be particular forms of an equation expressing the isothermal relation between molecular free surface energy and composition. The index *m* in van der Waals' formula $\gamma = a(1 - T/C_s)^m$ was found for all binary mixtures to be 1·197, and the total molecular free surface energy can be expressed as $\mu\{M/(d_l - d_g)\}^{2/3} = 2{\cdot}21(C - 0{\cdot}197T)$. The abnormalityof the surface tension of alcohols is explained by the assumption that alcohol is a binary mixture of single and triple molecules in equilibrium, and on this basis it is attempted to explain abnormalities in the observed vapour pressure, boiling point, and heat of vaporisation of alcohols.

P. H. B.

979. Volume of the Meniscus at the Surface of a Liquid. A. W. Porter. *Phil. Mag.* 17. *pp.* 511–517, *Feb.*, 1934. *Supplement.*—The volume of the meniscus, which is the volume contained between the surface of the liquid, the tangent to it at its middle point and the wall of the vessel, has been calculated for different values of cylindrical and conical tubes [see Abstract 111 (1933)]. Rayleigh's calculations and the tables of Bashforth and Adams have here been used to extend the results to various angles of contact. Graphs and tables are given so that the volume may be read off over a wide range of radii of tubes and angles of contact. An important historical case is cited in illustration of the need of the determination of the volume, and it is well to realise that this volume increases with the radius of the tube, becoming infinite for an infinite radius.

H. M. B.

980. Parachors of Substituted Methanes. D. L. Hammick and H. F. Wilmut. *Chem. Soc., J. pp.* 32–34, *Jan.*, 1934.—Negative parachor anomaly appears to be associated with certain atoms and groups in the molecule. The parachors of tetranitromethane, nitroform, and carbon tetrabromide were determined by direct observation of surface tension and density of the pure substances or of solutions of the substances. The parachor of diphenylmethane was calculated from published data and that of triphenylmethane was redetermined in view of the discordance of published data. Complete substitution of chlorine into methane produces no appreciable parachor anomaly. Bromine atoms and the nitro group have little effect until the fourth hydrogen atom is replaced, when marked anomalies (− 17, − 21) appear. The phenyl group produces suddenly a large anomaly (− 14) when only 3 methane hydrogens have been replaced. It is suggested that caution should be exercised with regard to cyclic structures involving singlet linkages. The system of parachor constants of Mumford and Phillips [see Abstract 496 (1930)] does not account for the determined parachors.

P. H. B.

981. Thin Films on a Water Surface. B. G. Whitmore, R. Richmond and H. A. McTaggart. *Roy. Soc. Canada, Trans.* 27. *pp.* 113–123, *May*, 1933.—Films were formed on the flat surfaces of acid-water solutions in a trough as used by Adam, the pressures being measured by a torsion wire. Films were also formed on convex surfaces on the horizontal upturned end of a capillary tube. The films were observed by microscope. With increase in concentration the liquid films of triolein, also of oleic acid, pass from the monomolecular state to one showing droplets with Brownian movement. The transition occurs at a lower pressure when the temperature rises, the films remaining liquid in both states, the lens-shaped drops having a volume of a sphere of diameter $0{\cdot}5\mu$. Palmitic and stearic acid films show Brownian movement at low pressures, but become rigid at higher pressures. Mixtures of triolein and palmitic acid give films partly liquid and partly rigid. Brownian movement appears when a solid film of tripalmitin is heated to its melting point. Benzyl benzoate on water spreads in an unusual way and forms a film which on compression exhibits the Brownian movement. It is uncertain how liquid films behave after the point of collapse when the droplets are brought closer together. It is reasonable to look on the film between the droplets as monomolecular, but a triolein film in the presence of microscopic droplets cannot sustain as great a pressure as in the presence of macroscopic lenses. P. H. B.

982. Profile of Liquid Films Draining on a Vertical Glass Plate. J. Satterly and H. Givens. *Roy. Soc. Canada, Trans.* 27. *pp.* 145–159, *May*, 1933.—This has been studied theoretically by Jeffreys and experimentally by Satterly and co-workers. The agreement between theory and experiment is fairly good, but small discrepancies form the subject of the present paper. It is now found that they cannot be surmounted by the addition of one fringe thickness to the film thickness [see Abstract 1356 (1933)]. Possible causes of the discrepancies are: (1) evaporation; but study of drainage when evaporation was virtually absent does not provide a solution; (2) non-uniformity of motion when producing the film; this is negligible in effect; (3) a difference between the viscosity of liquids in thin films and in the normal state; any change would appear to be in the wrong direction; (4) the top 4 mm. of draining film has hitherto been derived from the meniscus which exists against the plate prior to the plate's withdrawal from the liquid; this meniscus has now been eliminated without eliminating the discrepancy; (5) Jeffrey's equation may be incomplete, due possibly to the absence of a term involving surface tension; the treatment of this idea has yet to be completed. P. H. B.

983. Monomolecular Films of the Polyesters. S. A. Moss, Jr. *Am. Chem. Soc., J.* 56. *pp.* 41–43, *Jan.*, 1934.—It is shown that the polymeric acid and neutral ethylene succinates form a regular series of stable unimolecular films on dilute acid substrates. The films are similar to vapour-expanded films of fatty acid esters. Evidence is presented for the assumption that the molecular chains are flexible and can be closely packed before immersion on compression occurs. The closeness of approach is found to be 5·85 Å units comparable with the value 5·25 Å obtained from X-ray data. AUTHOR.

See also Abstracts 865, 867, 1326.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

984. Determination of the Axial Deformation of a Transit Instrument with Levels. H. Planner. *Zeits. f. Instrumentenk.* 54. *pp.* 1–12, *Jan.*, 1934.—The author refers to Starke and Kammerer's transit instrument which, when used to determine the azimuth constant "*k*," shows, according to Mayer's formula, an almost unchanging difference between the pole star combinations in upper and lower culmination with the same star periods. Also a determination of "*k*" from the pole star in upper culmination with another pole star in lower culmination yields always an almost undeviating value from other combinations. This permanent and almost undeviating difference leads to the conclusion that there must exist a systematic instrumental source of error. The instrument is examined to establish its deformation and to investigate its action on the inclination (i) and the azimuth of the horizontal axis. The deformation is expressed as a function of the zenithal distance, and a final reduction is made of the time determinations by establishment of the quantities δi and δk. It is shown that the variation of the azimuth error can be completely eliminated by consideration of these sources of error. R. S. R.

See also Abstracts 1058, 1070.

VACUA, HIGH.

985. Use of Charcoal in Maintaining High Vacua. C. H. Collie. *Phys. Soc., Proc.* 46. *pp.* 252–255, *March* 1, 1934.—Measurements have been made of the limiting pressures reached by charcoals and silica gels cooled with liquid air or liquid hydrogen when a small, constant stream of gas is admitted into the apparatus. AUTHOR.

986. High-Vacuum Leak. G. A. Whipple. *Phys. Soc., Proc.* 46. *pp.* 281–282; *Disc.*, 282, *March* 1, 1934.—The high-vacuum leak device described was designed for the control of pressure in the discharge tube of cold kathode-ray oscillographs. It operates on a diffusion principle, and in this case permits of continuous variation of discharge-tube pressures from 0·5 mm. mercury to black vacuum at 70 kV. Other applications of a diffusion leak are indicated. AUTHOR.

987. Hot-Wire Pointer Vacuum Gauge. H. Murmann. *Zeits. f. techn. Physik*, 14. 12. *pp.* 538–540, 1933.—Describes a gauge recording pressures from 1 to 10^{-3} mm. of Hg. A glass plate carries supports on which are mounted two platinum-iridium wires (diameter 51μ) which are heated by a 110-volt battery. The temperature of the wires depends on the gas pressure, so that the corresponding expansion is a measure of the gas pressure. In a manner similar to that used in hot-wire ammeters, the expansion of the wires is made to operate a pointer moving across a scale calibrated in mm. of Hg and marked on the glass plate. The current required is 45 mA, and the voltage across the wires varies from 600 mV at atmospheric pressure to 800 mV in a good vacuum. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

988. Theory of Viscosity of Liquids. Part I. E. N. da C. Andrade. *Phil. Mag.* 17. *pp.* 497–511, *Feb.*, 1934. *Supplement.*—The theory follows simple classical lines, no attempt being made to introduce quantum conceptions; it is approached from the point of view of the solid state, the density of which is not markedly different from that of the liquid state of the same substance: clearly the liquid near the melting point has much in common with the solid. It is assumed that the viscosity is due to the communication of momentum from layer to layer, as in Maxwell's theory of gaseous viscosity, but only by temporary union at the periphery of molecules in adjacent layers due to their large amplitude of vibration. In comparison with experimental results, those calculated theoretically are of the right order, and not only place the viscosities of closely packed liquids in the right sequence of magnitude, but give their relative magnitude. H. M. B.

989. Automatic Falling-Sphere Viscometer. B. A. Jones. *Indust. and Engin. Chem.* (*Analytical Edition*), 6. *pp.* 80–84, *Jan.* 15, 1934. —An automatic, modified falling-sphere type of viscometer for very viscous liquids has been developed and put into practical use as a factory-control instrument. The instrument is shown to give reproducible results for rubber cements and for petroleum products. In addition, it is demonstrated that viscosities obtained on this instrument are nearly proportional to absolute viscosities over a very wide range. AUTHOR.

See also Abstracts 925, 982, 1209, 1236.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

990. Photoelectric Photometry in the Infra-Red with the Loomis Telescope. J. S. Hall. *Astrophys. J.* 79. *pp.* 145–182, *March*, 1934.—It is shown that a cæsium oxide photoelectric cell may be used to measure stellar radiation in the infra-red, if cooled to approximately − 40° C. At this, and lower temperatures an obnoxious dark current is much weaker than the photo-current. The photometer, as attached to the Loomis telescope of the Yale University Observatory, differs from others chiefly in two respects: the cell is mounted in a thermos bottle in such a way as to be well insulated from heat and all drying is done chemically. The Pleiades were observed on several different nights for calibration purposes. ξ Geminorum was observed on thirty-three nights. Comparison with other data shows that the maximum and minimum observed in the infra-red are later than those observed in the visual. There is a corresponding phase difference between observations made in the blue and in the visual, the former being earlier. Colour observations, numbering 1240, were made on 347 stars by making intensity measurements at three effective wave-lengths. This list of stars, with the exception of Polaris, includes all those north of the equator brighter than 4·4 visual mag. The data show that the colours of these stars, measured in the infra-red, are closely related to those measured in the blue region of the spectrum. The obvious exceptions are stars of very early or very late spectral types. The observed *c* stars are slightly redder than the other stars of the same spectral class. The colour excesses of the observed early-type stars are not noticeably influenced by possible scattering due to the presence of interstellar matter. The possibility of finding the absolute magnitudes of giant stars later than F8 from their colour excesses, as observed in the infra-red, appears promising. AUTHOR.

See also Abstracts 984, 1033.

COMETS AND METEORS.

991. Motion of Matter in the Tail of Comet Morehouse. E. Cherrington, Jr. *Astron. J. No.* 1002. *pp.* 73–80, *Jan.* 4, *and No.* 1003. *pp.* 81–88, *Jan.* 11, 1934.—Positions of 14 condensations were measured on 26 photographs covering 1908, Sept. 29–Oct. 4, and Oct. 28–Nov. 1. Orbits were computed on the assumptions of motion in the orbital plane of the comet and under inverse square solar repulsion of unknown intensity. Simplifications of the computing labour are described. The residuals from the orbits are fully tabulated. The repulsive forces vary from 60 to 282 times gravity simultaneously,and over the month from 60 to 1367 times. The higher values confirm previous work and render the Bredichin classification of comets inadequate; they do not agree with Belopolsky's work on this comet; and they contradict the conception of a constant repulsive force operating in a comet. The fountain theory of comet envelopes is of questionable application in such a case. T. L. M.

992. Atomic Collisions and Radiation of Meteors. E. Öpik. *Univ. Tartuensis, Acta and Comm.* 26. [39 pp.], 1933. *In English.*—For small meteors (diameter a few cm.) the chief source of radiation (impact radiation) is collisions between atoms from the meteor and air molecules; these produce a line emission spectrum. Continuous radiation, due to electronic collisions, and from the nucleus of the meteor is unimportant. A method is given for calculating the visible radiation from a meteor of given velocity, mass and composition; this is applied to a typical case, a definite distribution of excitation levels being assumed. The minimum mass of a meteor is deduced from its luminosity, assuming its kinetic energy transformed into black body radiation at 6000° Abs. The heat factor, by which the minimum mass must be multiplied to give the probable true mass, is shown to be 400–20, decreasing with increasing size and velocity of the meteor. In the trail of a small meteor thermodynamic equilibrium is usually not attained, and, the radiating gases being in a state of under-excitation, the spectrum will consist mainly of the "raies ultimes," while the impact radiation will yield lines of the various ionised states of the atom. A theory of the dissipation of energy and efficiency of inelastic transitions in atomic collisions, based primarily on the assumption that the potential energy of resistance to interpenetration of two electronic orbits is equal to the smaller of the two ionisation potentials, is shown to give satisfactory results in the case of α-particles in air. [See Abstracts **1534 (1926), 2002 (1927) and 1788 (1930).**] C. A. S.

COSMOGONY.

993. Isotropic Models of the Universe, and the Stability of the Homogeneous and Static States. H. Dingle. *Roy. Astron. Soc., M.N.* 94. *pp.* 134–158, *Dec.,* 1933.—The manifolds are studied possessing the properties (1) of spherical symmetry about a point; and (2) of being occupied by matter whose condition is defined by a density ρ, and an isotropic pressure p. Static space is defined as that in which $\partial p/\partial t = \partial \rho/\partial t = 0$; and homogeneous space as that in which $\partial p/\partial r = \partial \rho/\partial r = 0$. The most general metric for manifolds satisfying these conditions cannot be obtained, but certain particular cases are found. In particular, the metric of a nearly homogeneous universe is worked out. The stability of a static manifold is discussed and it is shown that the Einstein universe must contract if condensations begin to form in it. It is also shown that the homogeneity of an expanding universe is stable and that of a contracting universe unstable. A number of other points in the theory of the expanding universe are also discussed. G. C. McV.

994. Distance in an Expanding Universe. A. G. Walker. *Roy. Astron. Soc., M.N.* 94. *pp.* 159–166, *Dec.,* 1933.—A definition of distance is given based on measurements of apparent size of nebulæ. In the case of an expanding universe whose metric is $ds^2=dt^2-\mathrm{R}^2(t)(\gamma^{-1}\,dr^2+r^2d\theta^2+r^2\sin^2\theta d\phi^2)$ where $\gamma=1-kr^2$, the distance, calculated in this way, of objects from the origin is $\mathrm{R}(t)r$. G. C. McV.

995. Variability of the Radius of Space. E. Reichenbächer. *Zeits. f. Astrophysik,* 7. *pp.* 369–372, *Dec.* 23, 1933.—Theoretical support is given to the hypothesis favoured by the author that the radius of space is determinable from the distances of the spiral nebulæ. G. C. McV.

996. Formation of the Earth. R. Perrin. *Comptes Rendus,* 198. *pp.* 105–107, *Jan.* 3, 1934.—A scheme is set out for the formation of the earth involving gas, initially at a high temperature and low pressure, with oxygen in the free state in equilibrium with different metals and metalloids and their oxides. The earliest oxides formed mainly contain

silica and equilibrium is obtained between the vapour pressure of the liquid formed and that of the free oxygen. This liquid crust forms before the nucleus solidifies. Carbon plays a less predominant part, forming first CO and later CO_2 also. Stars composed mainly of light elements are not considered dead, but life has not commenced, all the oxygen being fixed in the rocks or developing forms of life different from those in the earth.
R. S. R.

See also Abstract 961.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

997. Orbits in the Problem of Three Bodies. M. Kiveliovitch. *Bull. Astronomique*, 8. 2. *pp.* 71–75, 1932.—In the classical problem of three bodies, the condition is found that the orbit of one of the bodies should intersect one of the coordinate planes, it being assumed that there are no collisions. G. C. McV.

998. Periodic Orbits in the Restricted Problem of Three Bodies. P. Pedersen. *Roy. Astron. Soc., M.N.* 94. *pp.* 167–185, *Dec.*, 1933.—It is proved that the period of the periodic orbits around the libration points is a function of the size of the orbits, when terms of the second and third order are retained in the series expressions. This holds under the limitation that one of the finite masses has, approximately, the critical mass μ_0, whilst the other is, approximately, of mass $1-\mu_0$. It is also shown how the critical values of the masses depend on the size of the orbits. It also follows that classes of periodic orbits with infinitesimal limiting orbits exist for values of the smaller mass which are greater than the critical value μ_0. G. C. McV.

999. Elliptic Osculating Orbits in the Problem of Two Bodies of Decreasing Mass. E. Merlin. *Comptes Rendus*, 197. *pp.* 1723–1725, *Dec.* 26, 1933.—The problem is whether the hypothesis of decreasing mass of stars permits the retention of an elliptic osculating orbit. This is suggested by the history of double stars. The author examines conditions that the eccentricity shall remain less than 1, on the basis of a previous paper [see Abstract 3401 (1933)], and concludes that if the sign of the motion of the periastron is that of the change of radius vector, and the acceleration of the periastron converges to a finite limit, the orbit remains elliptic. T. L. M.

1000. Limiting Case of the Problem of Two Bodies. H. Tallqvist. *Soc. Scien. Fennica, Comm. Phys.-Math.* 7. 4. [110 *pp.*], 1933.—The motions of a test particle, according to Newtonian mechanics, acted on by (1) a doublet, (2) a doublet and an inverse-square attraction, and (3) a doublet, an inverse-square attraction and a radial force proportional to the distance, are investigated in the minutest detail. G. C. McV.

1001. Determination of Trajectory of a Body Moving in Planetary Space by an Observer Situated on the Moving System. A. J. Sternfeld. *Comptes Rendus*, 198. *pp.* 333–334, *Jan.* 22, 1934.—Two points on the plane trajectory of the moving body are taken, the two radius vectors r_n and r_{n+1} from the sun subtending an angle α, and if the time interval is sufficiently short, a knowledge of these three quantities will fix the trajectory. If the form of the orbit is known, then the whole of it can be found from the measurements of one segment. It is suggested that (1) r can be obtained in terms of the absolute temperature (T) of equilibrium of the body when this is low, since from the Stefan-Boltzmann law $r=K/T^2$, where K is a constant characteristic of the body; (2) α can be obtained by using a gyroscopic system which has its axis fixed absolutely, this being realised by a black chamber in which the plane of the orbit is fixed by reference to fixed stars and it agrees with that of solar rays entering the vessel. R. S. R.

NEBULÆ.

1002. Catalogue of 985 Extra-Galactic Nebulæ in a Region in Fornax and Eridanus. R. H. Baker. *Harvard Coll. Obs., Ann.* 88. 3. *pp.* 79–90, 1933.—Of the objects here catalogued, 925 have not been before recorded. To each nebula is assigned its position, integrated apparent magnitude, grade of central concentration, degree of elongation, maximum angular diameter, and surface magnitude. The distribution is shown in a map. M. A. E.

1003. Survey of 1346 Variable Stars in the Large Magellanic Cloud. H. Shapley and J. Mohr. *Harvard Coll. Obs., Ann.* 90. 1. [25 *pp.*], 1933.—The Magellanic clouds are so rich in Cepheids, that better and fuller data for this type of variable star can be gathered there than in our own galaxy. Miss Leavitt discovered 808 in the Large Cloud in 1904. Her survey has now been revised and extended, and the number brought up to 1346. It will be long before the periods and light curves of all these can be determined, but the apparent median magnitudes and the ranges have been found, and the absolute magnitudes and periods deduced. The periods show a steadily increasing frequency from 40 days to about 3 days, periods over 38 days being rare. A considerable number of supergiants in the cloud are Cepheids, and they seem to be most numerous along its axis. The amplitudes are widely dispersed, and the mean is $1^{m}\cdot05$. It has been thought that a correlation exists in Cepheids between amplitude and period, but this research, so far as it goes, does not support the hypothesis. M. A. E.

1004. Symmetry of the Spiral Arms. E. Reichenbächer. *Zeits. f. Astrophysik*, 7. *pp.* 364–368, *Dec.* 23, 1933.—A general discussion is given of the cause of the spiral arms of nebulæ. Tidal action, produced by the first stars formed, is favoured. G. C. McV.

1005. Absolute Intensity of the Nebular Lines. E. U. Condon. *Astrophys. J.* 79. *pp.* 217–234, *March*, 1934.—The quantum mechanical theory of the transition probability for transitions due to magnetic dipole and electric quadripole radiation in atomic spectra is briefly developed and applied to the calculation of transition probabilities in p^2, p^3, p^4 configurations. It is found that the nebular lines N_1 and N_2 are essentially due to magnetic dipole radiation, the quadripole being but 0·1 % as intense. Numerical values of the transition probability for all possible combinations in the $2p^2$ configuration in CI, NII, and OIII are given, also for $2p^4$ in OI and $2p^3$ in OII and for the transauroral pair in $2p3p^3$ SII. [See also Abstract 4891 (1932).] AUTHOR.

PLANETS.

1006. Markings and Rotation of Mercury. E. M. Antoniadi. *Roy. Astron. Soc., Canada, J.* 27. *pp.* 403–410, *Dec.*, 1933.—The author reviews the observations of the planet's markings from Schröter's in the beginning of the 19th century to those by Schiaparelli between 1881 and 1889. The latter observations were of Mercury on the meridian in daylight and Schiaparelli concluded that the rotation was $87^{d}\cdot 969256$ round an axis almost perpendicular to the orbital plane. Graff (about 1929) controverted this on the basis of his radiometric measures, but the author confirmed it by his observations with the 33-in. reflector of Meudon in the years 1927, 1928 and 1929; finding that the markings are fixed as regards the terminator, but show a pronounced libration such as would be necessitated by a uniform rotation equal to the period and about an axis not quite 7° out of the perpendicular to the orbit. A map is given of the markings; the planet shows in daylight a colour like that of the moon in twilight: that is yellowish with a slight roseate tinge, and a neutral-grey in the (southern) dusky areas. These dusky areas appear larger in the 33-in. than in Schiaparelli's smaller telescope; this is due to diminished diffraction in the larger glass and proves the reality of these markings. This map confirms Schiaparelli's markings and those of de Ball, Denning, Jarry Desloges, Fournier and Danjan, but not those of Lowell. The author shows that Mercury bears the same relations to the sun that Iapetus does to Saturn, and this satellite presents a constant face to its primary, from which it may be inferred that Mercury does also. Seeing that Mercury's atmosphere is invisible, it is remarkable that its clouds are more pronounced than those of Mars, and frequently veil the markings. The author attributes this veiling to violent dust storms due to the perihelion heat. Mercury has rough surfaces, and its albedo indicates that its surface presents eruptive rocks of basalt and dark lava. A. S. D. M.

1007. Correlation of Inclination and Eccentricity in Asteroid Orbits. P. Bourgeois and J. F. Cox. *Comptes Rendus,* 198. *pp.* 53–54, *Jan.* 3, 1934.—The correlation, known since 1891, has been studied for 1152 planets by modern statistical methods: $r = 0\cdot 19$. The same correlation coefficient for the elements referred to the plane of Jupiter's orbit, prepared by Fayet, is 0·21. The authors conclude that the orbit of Jupiter has no distinctly significant situation with reference to the asteroid ring. T. L. M.

1008. Photometric Theory of Lunar Eclipses. F. Link. *Bull. Astronomique,* 8. 2. *pp.* 77–108, 1932.—The object is to compute the optical density of the shadow cast on the moon. The theory takes account of the distribution of brightness over the sun's disc, but not its variation of apparent diameter; the flattening of the earth and the mean seasonal and local variations of the structure of the earth's atmosphere are considered. The altitude to which the density of the earth's atmosphere is known limits the range of the theory; within these limits a good approximation to the mean optical density is possible; and tables for three values of parallax and three regions of the spectrum are given to meet all possible cases. Comparison with observation shows that the ozone layer must begin at an altitude of about 20 km., which is lower than general consideration of the data suggested. The existence of a high absorbing layer (at about the altitude of the Heaviside layer) is confirmed. Notes as to observation are added, dealing with the choice of screens and the best parts of the shadow to observe. T. L. M.

See also Abstracts 996, 1001.

STARS.

1009. Atmospheric Extinction Factor in Photoelectric Photometry. W. M. Smart. *Roy. Astron. Soc., M.N.* 94. *pp.* 115–130, *Dec.,* 1933.—A general discussion is given of the determination of the atmospheric extinction factor "*f*" for use in precise photometric observations. A general formula for the effect of atmospheric extinction is derived which is applicable to zenith distances of about 75°; the formula is $m - m_0 = f \sec. z - 0{\cdot}003 f \sec^3 z$, where m is the observed magnitude of a star, m_0 its true magnitude and z the zenith distance of the star. It is shown that under good conditions observations of variable stars which transit at zenith distances up to about 70° ought to be entirely practicable. Two methods for finding the value of "*f*" accurately are given, and are illustrated by means of recent observations of δ Persei, η Pegasi and β Draconis. J. E. K.

1010. Stellar Parallaxes Determined Photographically at the Cape Observatory. (5th List). *Roy. Astron. Soc., M.N.*, 94. *pp.* 185–190, *Dec.*, 1933.—A continuation of previous lists [see Abstract 4180 (1932).]

1011. A-Stars in the Ursa Major Stream. C. Bertaud. *Bull. Astronomique*, 8. 2. *pp.* 109–122, 1932.—The author calculated the velocities in space of 526 A-stars and has recognised a tendency in them to group movement. A preliminary selection shows 123 stars as possibly belonging to the Urs. Maj. stream and diagrams give the amounts of velocity (uncorrected for solar motion) in and perpendicular to the equatorial plane. Another table gives for 11 of these stars, discussed by Rasmussen, the velocity projections, absolute magnitudes and spectral class, all being of type A_0 to A_2 except 8 U Ma (A_5) and 37 U Ma (F_0). Adopting 20 km./sec. for the sun's motion, it is found that $\alpha = 270°$, $\delta = +30°$, $A_0 = +285°{\cdot}4$, $D_0 = -1°{\cdot}5$, $V_0 = 29{\cdot}6$ km./sec.; or in galactic coordinates $G_0 = +0°{\cdot}8$, $g_0 = -5°{\cdot}0$, approximating to Rasmussen's. If X, Y, Z are the velocity projections for the 123 stars and $R = \sqrt{(X - X_0)^2 + \text{etc.}}$, then an upper limit for R is 14 km./sec., but in use, R is limited to under 10 km./sec. The stars are divided into 5 groups as R satisfies the inequalities; tables give the adopted parallaxes and radial velocities; diagrams give the velocities in and perpendicular to the galactic plane, and the projections of the stars and their velocities on the same planes. A final table gives the vertex of the groups as a function of R in galactic coordinates. A. S. D. M.

1012. Star Streams in the Neighbourhood of 14 h R.A. and 52° Dec. A. Bemporad. *Accad. Lincei, Atti*, 18. *pp.* 177–184, *Sept.*, 1933. —There is a remarkable agreement in the proper motions in this zone and in the zone 54° [see Abstract 3408 (1933)], though the stellar density is very different in the two zones. [See following Abstract.] A. D.

1013. Star Streams in the Neighbourhood of 16h R.A. and + 52° Dec. A. Bemporad. *Accad. Lincei, Atti*, 18. *pp.* 425–433, *Nov.* 19, 1933.—The speed and direction of stars in this region which show proper motions are analysed, and are compared with those in adjoining regions, as in five preceding papers. [See preceding Abstract.] M. A. E.

1014. Faint Southern Double Stars with Common Proper Motion. (2nd List). W. J. Luyten. *Roy. Astron. Soc., M.N.*, 94. *pp.* 191–192, *Dec.*, 1933.—A continuation of previous work [see Abstract 2265 (1933)].

1015. Anomalous Multiplet Intensities in Stellar Spectra and Sunspots. A. D. Thackeray. *Roy. Astron. Soc., M.N.* 94. *pp.* 99–115, *Dec.*, 1933.—The results of a spectraphotometric study of 30 late-type stars are collected and discussed. The probable error of a single line is estimated at about 20 %. The $a^5F-Z^5D^0$ multiplet of Fe consisting of twelve members (5269—5506) is measured and there appears to be a marked strengthening of the weak lines (Minnaert-Woolley effect) in K5 and M stars. Similar anomalous strengthening appears from solar disc to solar spot spectrum for low-potential multiplets and the effect increases with height in the atmosphere. Of possible explanations, interlocking, involving a lack of thermodynamical equilibrium, seems to fit the facts best. It is shown that a correction may have to be applied to the method of interpreting equivalent widths by using the Russell-Adams calibration of Rowland's scale as a result of the multiplet anomalies. This correction might have an important bearing on ionisation temperatures obtained by the Russell-Adams method, chiefly in the direction of raising the temperatures of late type stars. J. E. K.

1016. New Calculation of the Term System of Si IV. B. Edlén and J. Söderqvist. *Zeits. f. Physik,* 87. 3–4. *pp.* 217–219, *Dec.* 23, 1933. —New measurements in a vacuum are made of the terms of Si IV. Newly identified lines of longer wave-length allow the terms to be correctly related. The series limit has been accurately determined. These lines are of importance for the interpretation of the spectra of hot stars. [See following Abstract.] H. L. B.

1017. Interpretation of the Spectra of Hot Stars. B. Edlén. *Zeits. f. Astrophysik,* 7. *pp.* 378–390, *Dec.* 23, 1933.—Observed and calculated lines of the spectra of C III, C IV, N IV, N V, O IV, O V, O VI are tabulated [see preceding Abstract], and are used to interpret three typical Wolf-Rayet spectra, micro-photographs of which are given. H. L. B.

1018. Relative Intensities of Balmer Lines in Stellar Spectra. S. Günther. *Zeits. f. Astrophysik,* 7. *pp.* 391–393, *Dec.* 23, 1933.—Assuming that the forms of the higher members of the Balmer series are determined essentially by the effect of pressure one can very simply deduce the relation $E_2=\gamma E^2_1$, where E_2 is the total absorption of a high member of the Balmer series, E_1 is the total absorption of Hα and γ has a separate determinate value for each of the higher series members. It follows from this that the total absorption of the higher members of the Balmer series increases more rapidly with the number of H atoms than that of Hα or Hβ. This is confirmed by values of the ratios of the total absorptions Hα/Hγ and Hβ/Hγ given in the paper to which this note refers [see Abstract 4400 (1933)]. The differences of total absorptions depend more on the total absorptions themselves than on spectral type. It is obviously not permissible to calculate the total absorption of one Balmer line from that of another on the assumption that the ratio of the absorptions is the same in all stars and equal to that of the C-stars with a total absorption of 2Å.

J. E. K.

1019. Invisible Starlight. P. W. Merrill. *Science,* 79. *pp.* 19–24, *Jan.* 12, 1934.—Describes the progress that has been made in determining the character of the light emitted by stars, from measurements of the starlight received at the earth's surface. Attention is directed to the ultraviolet and infra-red regions of the spectrum. Difficulties due to absorption by the atmosphere, or by the lenses, prisms, mirrors, etc., used in the receiving apparatus, the development of red sensitive photographic plates and the application of radiometric methods based on a temperature-rise, are all briefly reviewed. The main features of star spectra so far observed are indicated. W. S. S.

1020. Influence of Certain Photographic Errors on the Profiles of Absorption Lines in Stellar Spectra. C. T. Elvey and Christine Westgate. *J.O.S.A.* 24. *pp.* 43–50, *Feb.*, 1934.—A study has been made of the Eberhard effect in its relation to the profiles of absorption lines. Measurements have been made of the depression of the background at the edge of an image, due to the inhibiting action of the products of development, for (*a*) various differences between the density of the image and that of the background; (*b*) constant ratio of exposure of image to exposure of background, but different total densities; (*c*) varying time of development; (*d*) agitation during development; and (*e*) type of developer. The influence of scattered light from the back of the plate and the influence of the graininess of the emulsion have also been studied. The conclusion is reached that for Eastman 40 plates developed in D-11 at 70° F., and with a density of the continuous spectrum less than unity, the Eberhard effect and the halation from the back of the plate have a negligible influence on the profile of an absorption line. The profiles of artificial absorption lines are shown. AUTHORS.

1021. Photography of the Near Infra-Red Region of Stellar Spectra. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 486. *Astrophys. J.* 79. *pp.* 183–202, *March*, 1934.—This paper describes the chief features shown by a photographic reconnaissance of stellar spectra in the region λλ 7000–9000Å, made with a plane-grating spectrograph attached to the 100-inch telescope. Most of the spectrograms are of dispersion 33Å/mm. and show the region λλ 8320–8900, which is free from serious interference by terrestrial lines and includes a number of stellar lines of special interest. Radial velocities from infra-red lines agree well with each other and with previous determinations from lines in the blue-violet region. The chief lines in the infra-red spectrum of α Cygni are due to H, N I, O I, Mg II, Ca II. The Paschen series of hydrogen lines is conspicuous in A-type spectra, especially those having the "c" characteristic, *e.g.*, α Cygni, β Orionis. The lines of Ca II λλ 8498, 8542, 8662 are prominent in types A–M and may have an interesting relationship to absolute magnitude. They were found to be bright in the spectrum of R Hydræ. The O I lines λλ 772, 774, 775, and 8446 are important in types A and F. They appear very sensitive to absolute magnitude, being more intense in the brighter stars. Lines of neutral Ca, Ti and Fe dominate spectra of classes K and M in the region λλ 8320–8840. Many band heads were measured in spectra of class M. Most of them, especially in the λ 7000 region, are due to TiO. A comparison of N-type spectra with furnace spectra taken by King shows that a large part of the complex structure between λ 6910 and λ 8780 is due to absorption by cyanogen. AUTHOR.

1022. Spectroscopic Phenomena of the Eclipse of ε Aurigæ. D. B. McLaughlin. *Astrophys. J.* 79. *pp.* 235–245, *March*, 1934.—Radial velocities of ε Aurigæ during eclipse, observed at Ann Arbor, differ systematically from the Yerkes velocities, probably because of the asymmetries of the spectral lines. The intrinsic variations of light are synchronous with the velocity variations, with a period of a few months. The relation of light- and velocity-curves is somewhat like that of a Mira star of short period, velocity maximum slightly preceding light maximum. Systematic residuals of several lines are discussed. The largest were those of the hydrogen lines, positive before mid-eclipse and negative afterward, with a range of about 25 km./sec. The Mg II line 4481 shows a residual curve almost the inverse of the velocity-curve. These residuals are readily explained as due to differing amounts of asymmetry of the lines, 4481 showing no asymmetry and the hydrogen lines being most strongly affected. Study of the edges of the hydrogen lines shows that their residuals are due to a flaring-out of the red edge before mid-eclipse and of the violet edge afterward, while the other edge in each case remains near its normal position. All the line residuals and asymmetries can be explained by the shifting of a strong line across a weaker one at mid-eclipse. A very similar phenomenon is known to occur in the spectrum of β Lyræ during primary eclipse. It is suggested that these anomalous lines are produced in some way by the absorption of light of the bright star by the atmosphere of the fainter. The lack of similar effects in other eclipsing binaries is attributed to the smaller extent of the atmospheres of most stars as compared with those of supergiants. AUTHOR.

1023. Intensities of Some Multiplets of Fe II and Ti II in Stellar Spectra. C. T. Elvey. *Astrophys. J.* 79. *pp.* 263–270, *March*, 1934.—The total absorptions of eight lines each of Fe II and Ti II were determined from spectrograms of three-prism dispersion for the stars 10 α Canis Minoris, 24 γ Geminorum, 33 α Persei, 41 Cygni, 50 α Cygni, 17 Leporis, 7 ϵ Aurigæ, and 3 α Lyræ. The relative intensities of these lines were compared the with square roots of the emission intensities as observed in the flash spectrum and marked deviations from the square-root law were found. AUTHOR.

1024. Equations of State in Stellar Models. J. Meurers. *Zeits. f. Astrophysik*, 7. *pp.* 350–356, *Dec.* 23, 1933.—In a stellar model in which the gas-pressure is given by $P=C_2 p^\mu T^\nu$ and where it is assumed that $T=\theta p^m$ (C_2, μ, ν, θ, m are constants), it is required to find which models have the same density distribution. It is proved that, for given θ and m, all the models for which $\mu+m\nu=const.$ and $C_2\theta^\nu=const.$, have the same density-distribution, provided radiative equilibrium is assumed. Conversely it is shown how to find the values of C_2, μ, ν in a model for which the density and the temperature distribution are given. The models dealt with are more general than the polytropic ones and the connection between the two types of model is explained. G. C. McV.

1025. Distribution of Nearer Stars and Masses of Visual Binaries. A. van Maanen. *K. Akad. Amsterdam, Proc.* 36. 10 *pp.* 870–876, 1933.—The author uses the material from a card catalogue of parallaxes: (1) for a discussion of 617 objects within 20 parsecs of the sun. The central region of 5 parsecs radius is divided into two equal volumes, and using the single, the double and the multiple stars, it is found that there are 24 in the central part and only 15 in the outer shell, the great majority being of very faint absolute magnitude; no star as yet has been found fainter than magnitude + 16·6 (visual), and it is evident that even in our neighbourhood we do not know all the stars. Applying the same method to the outer regions it is found for $\pi = 0''\cdot050$ to $0''\cdot099$, that the expected stars equal to or fainter than the 10th magnitude are 1297 in excess of the observed (which number only 35). Similar results hold for the densities in outer shells as compared with the inner. A figure is given for 3 zones, by plotting spectral type against absolute magnitude. No star has an absolute magnitude larger than 0, and only in the central region do the stars fall fairly well on the Russell-Hertzsprung diagram. The author points out the difficulty in finding white dwarfs. (2) 94 modern parallaxes are available from Aitken's

New Catalogue of Binaries for the derivation of absolute magnitudes and masses of the systems; comment is made on four stars (Σ 3062, Σ 277, Φ Ursae Majoris, β 80). It is found that even for systems with well determined data, the dispersion in the masses is considerable, and this is inherent in the masses rather than in the uncertainties of the observational material. [See Abstract 5206 (1933).] A. S. D. M.

1026. Eccentricity of Long-Period Double Stars. D. Barbier. *Comptes Rendus*, 198. *pp.* 151–153, *Jan.* 8, 1934.—The author examines three methods for obtaining some estimate of the eccentricity where the orbit is not yet known. All assume that any mean anomaly is equally probable, which may be only approximately true. One is Russell's method based on the cotangent of the angle between radius vector and tangent to the orbit both projected on the celestial sphere. In the other cases the author discusses two other functions, one involving the second derivative of the radius vector, the other the mass and parallax of the system. T. L. M.

1027. Photographic Light Variation of RS Ophiuchi. (Mrs.) G. C. Flammarion and F. Quénisset. *Comptes Rendus*, 198. *pp.* 154–156, *Jan.* 8, 1934.—The history of the star (which is Nova Ophiuchi, 1898) is given, with an account of the outburst of August, 1933. The results of photographs at Juvisy Observatory, from August to October, 1933, for magnitude and colour index are reported. T. L. M.

1028. β Cephei. C. C. Crump. *Astrophys. J.* 79. *pp.* 246–262, *March*, 1934.—The elements of nineteen new and separate determinations of the orbit of β Cephei are here given with a list of seventeen other determinations which have been made at different times by other observers. The material presented for study covers a period of twenty-six years and more than fifty thousand complete ranges of the variation of the radial velocity of this star. AUTHOR.

1029. Systematic Corrections to Photographic Magnitudes of Polar Stars. F. H. Seares and Mary C. Joyner. *Mt. Wilson Observat. Contrib. No.* 489. *Astrophys. J.* 79. *pp.* 203–216, *March*, 1934.—Provisional systematic corrections for the reduction of six catalogues of photographic magnitude to the international system—Greenwich 1, Simeis, Harvard-Payne, Leiden-De Sitter, Göttingen Aktinometrie and Yerkes Actinometry—have been tested with the aid of a working list of magnitudes for 373 stars (WPg) based on these corrections. AUTHORS.

See also Abstracts 990, 1003.

SUN.

1030. Polarisation of Light in Solar Prominences. B. Lyot. *Comptes Rendus*, 198. *pp.* 249–251, *Jan.* 15, 1934.—Fourteen prominences have been studied during daylight and reveal polarisation of the light they emit. Equatorial prominences were found to be less polarised than prominences elsewhere. Their planes of polarisation deviate from the normal to the sun's surface by amounts up to 22°; northern prominences being deviated towards the north, southern prominences towards the south. G. C. McV.

1031. Ultra-Violet Radiation of the Sun. M. Minnaert. *Physica*, 13*e*. 9. *pp.* 277–284, 1933.—Gives a short summary of our knowledge of ultra-violet radiation by the sun; its effect in the atmosphere; its absorption in the ozone layer and the progressively increasing density of this layer; and finally its climatic influences. A. D.

1032. Spectroscopic Determinations of the Sun's Rotation during 1931, 1932, 1933. A. Belopolsky. *Zeits. f. Astrophysik,* 7. *pp.* 357–363, *Dec.* 23, 1933.—The observations were carried out in Pulkovo. The available observations from various sources and including this new material show a diminution of the velocity of rotation from 2 to 1·8 km./sec. during the period 1890–1933. A more accurate determination of the velocity, using only measurements of spectral lines of the same intensity and of one element only, is required before definite conclusions as to the speed of rotation can be drawn. G. C. McV.

1033. Spectroscopic Observation of Reversing Layer during Partial Solar Eclipse. H. Dingle. *Roy. Astron. Soc., M.N.* 94. *pp.* 62–68, *Nov.,* 1933.—The problem is to arrange apparatus so as to be rapidly adaptable to photograph both the bright-line spectrum and the cusp until near totality, and then the Fraunhofer spectrum near the limb. The author discusses the best position for the grating, the use and adjustment of a prism for rotating the image from the coelostat so as to bring the points successively required on to the slit, and the calculation of the position angles of the cusp. T. L. M.

1034. Detection of Small Doppler Shifts in Solar Spectrum. J. Evershed. *Roy. Astron. Soc., M.N.* 94. *pp.* 96–98, *Dec.,* 1933.—The positive on negative method for measuring small shifts in spectrum lines, first described by the writer in 1913, has been applied with special modifications to some of Hale's spectra on which he based his discovery of a general magnetic field in the sun. Shifts of the order of 0·001 Å can be measured with certainty by this method, and the general result was very satisfactory, showing the right order of shift and the right sign in the two hemispheres of the Sun. But anomalies were found, which might be due to disturbing effects of small Doppler shifts. A special effort has therefore been made to discover whether these do occur, and 24 high-dispersion plates have been secured with four transmissions through the liquid-prism spectrograph of Ewhurst Observatory. In all of these, small shifts and sinuosities are seen in the narrower lines, which must seriously disturb the measures of Zeeman effect in the general magnetic field. If the observed shifts are Doppler effects, the movements causing them must be mainly parallel to the sun's surface, and they seem to be extremely local. They are apparently confined to the lower reversing layer, and perhaps may be incipient sunspot disturbances. M. A. E.

See also Abstracts 1015, 1047, 1048, 1129.

GEOPHYSICS.

GEODESY.

See Abstract 939.

GEOPHYSICS, APPLIED.

1035. Horizontal Loop Induction Method of Geoelectrical Prospecting. A. Graf. *Beitr. z. angew. Geophys.* 4. 1. *pp.* 1–75, 1933.—The advantages of using a small primary loop, laid horizontally, in inductive geoelectrical prospecting are summarised, and the theory is given of the use of circular loops, varying in radius between 1 and 100 m., energised by a.c. of frequencies between 10 and 1000. The characteristics of the primary electromagnetic field of a loop are obtained by analytical and graphical methods, and the secondary eddy-current field induced in neighbouring conductors, especially thin infinite horizontal sheets, is examined. Finally, the components of the secondary electromagnetic field are derived, by similar methods, from formulæ which are in the first place limited to cases where the quantity f, which varies as the product of the frequency ν of the primary current and the conductivity σ of the conducting sheet, is small. From a consideration of the soluble case when f is very large, correction curves are drawn for intermediate values of f. Graphs are given showing the variation of the field components with the depth of the conductor below the loop and with f. Particular attention is paid to two measuring points, one P_0 at the centre of the primary loop and the other P_6 at a radial distance from it six times the radius of the loop. The latter serves as a typical point in the outer area, convenient for measuring the field components. Next are considered the components for a thick plate and for the earth currents as a whole. The estimation of the depth of the conductor is shown to depend on a quantity Z, which in turn depends both on f and the ratio β of the depth to the radius of the loop. f can be varied by changing the frequency of the primary loop, and β by changing the radius of the loop. The most efficient method of depth determination consists in determining the loop radius corresponding to a maximum field-strength at a special observing point, *e.g.*, P_0 the centre of the loop of the other point P_6 above mentioned. Examples of this method are discussed in three practical instances, concerned respectively with the determination of local rock conductivity, ground water depth, and depth of salt water horizon. As a variant on the previous graphical integration method, the primary and secondary fields are derived analytically on the assumption that the loop is equivalent to a pulsating magnetic dipole located at its centre. A comparison shows that the resulting field components vary only slightly from those previously determined, and the dipole field formulæ are then used to determine the secondary field due to a conducting sheet of which the plane is inclined to the horizontal. Finally, the field-curves so obtained for determining depth and inclination are compared with those obtained in the ordinary resistivity method.
E. L. J.

See also Abstract 1058.

HYDROSPHERE, PHYSICS OF THE.

1036. Mechanics and Thermodynamics of Glaciers. M. Lagally. *Gerlands Beitr. z. Geophys., Supplementband* 2. *pp.* 1–94, 1933. —Heat for raising the temperature of glacier ice has two sources: (1) transformation of mechanical energy. This may be either from the compression of the ice through pressure, the effect of which is negligible; or from the work produced by the fall down the valley. A fall of 100 m. is able to raise the temperature of the ice by ½°, and so, when the glacier reaches the position of the zero isotherm, raises the ice temperature above melting point. This heating however, is not uniformly distributed through the thickness of the glacier, but is concentrated near to the base. (2) Sources outside the glacier itself. Atmospheric changes of temperature penetrate only a few meters, and have only a secondary significance, but conduction from the earth's crust is more important, for it produces a temperature gradient of 1° for each 20 m., and is able, when the ice is at the melting point, to melt a layer 1 cm. thick at the base of the glacier in a year. The relation of the mean surface temperature and the temperature gradient produces in thick glaciers a critical layer below which all the ice is above the melting point. The plasticity of the ice increases rapidly near the melting point, and therefore the hypothesis of viscous flow is supported. But it must be remembered that the coefficient of viscosity varies with each condition of the ice, and hence different kinds of glacier movement are likely to be found. For example, the glacier tongues in Alpine valleys consist of highly plastic ice, whilst in the upper ice-fields the ice is cold throughout. The paper contains a discussion of the physical properties of ice. W. A. R.

See also Abstract 948.

LAND, PHYSICS OF THE.

1037. Earth-Vortex, Échelon Faults and Allied Phenomena. S. Fujiwhara, T. Tsujimura and S. Kusamitsu. *Gerlands Beitr. z. Geophys. Supplementband.* 2. *pp.* 303–360, 1933. *In English.*—Examples alleged to indicate a circular or vortical movement of small or large portions of the earth's crust relative to other portions, or at least a spiral arrangement of faults, dykes, volcanoes, etc., are described, *e.g.*, in the neighbourhood of the Huzi volcano (Japan), or between Celebes and New Guinea. Examples of an échelon arrangement of faults and lines of volcanoes are also given with a proposed explanation of their mode of origin. Both theories are illustrated by numerous examples of artificially produced distortions of or cracks in suitable materials. C. A. S.

1038. Geothermal Measurements. S. Kraskowski. *Beitr. z. angew. Geophys.* 4. 1. *pp.* 76–87, 1933.—Observations of geothermal phenomena and gradients made in 1932 at Kharkov and Moscow are described. The former were made in artesian well boreholes, which passed through some 550 m. of cretaceous formation, and showed a steady rise of temperature during transit of this formation, followed by an abrupt increase in temperature gradient as the underlying sand was reached. The Moscow observations showed how little disturbance in the geothermal phenomena was caused by casing the drill holes. E. L. J.

1039. Thermal History of the Earth. J. H. J. Poole. *Roy. Dublin Soc., Proc.* 21. *pp.* 9–22, *Jan.,* 1934.—The author refers (1) to Jeffrey's contraction hypothesis and the assumptions made regarding the distribution of radioactive elements in the earth involving no convectional heat flow and no change of state of the medium, and (2) to Holmes' theory in which convection currents act continually and may reach to very great depths in the earth [see Abstract 3432 (1933)]. The difficulties in these theories are discussed and it is concluded that (1) the condition for the existence of a permanent convective layer in the earth is that below a certain depth the adiabatic gradient is greater than the freezing-point gradient; (2) the distribution of radioactivity in the original crust of the earth could not have been that required by the cooling earth theory, and consequently remelting of the original crust must have occurred; (3) the present distribution of radioactivity is most easily explained on some theory which allows for refusion of the crustal materials; (4) the presence of a permanent convective layer in the earth at moderate depths will introduce shearing stresses in the crust, and the nature of the stress renders it likely that the convective layer, if it exists, must be denser than the overlying crust; (5) Holmes' convection theory, while it may diminish worldwide tension in the crust, cannot entirely eliminate it during the periods in which the thermal energy of the earth is increasing. R. S. R.

1040. Unsteady Flow of Fluids in Oil Reservoirs. W. Hurst. *Physics,* 5. *pp.* 20–30, *Jan.,* 1934.—This paper is an analysis of the unsteady flow of a compressible fluid flowing radially to a well in a sand formation. The unsteady flow occurs as a result of fluid expansion. When the pressure in the formation is lowered, the fluids therein expand and flow towards the region of lowest pressure. By the " equation of continuity," the solution for two specific cases of unsteady flow are derived. The first of these is that in which the fluid from a sand reservoir of limited size flows to a well in which the pressure at the level of the producing sand always remains constant. The variation of the pressure gradient, the rate of production, and the cumulative production with respect to time are worked out. In the second case the flow is such that the rate of production at the well is constant. The equations for the pressure gradient and the decline of pressure at the well with respect to time are given. AUTHOR.

See also Abstracts 939, 1036.

METEOROLOGY.

1041. Methane in the Atmosphere. S. Suzuki. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 35–38, *Jan.,* 1934. *In English.*—Under the supposition of the diffusive equilibrium of the air in the stratosphere, the distribution of methane at high levels is calculated and it is found that its proportion in the air reaches a maximum at 100 km. approximately unless no remarkable ionisation occurs there. AUTHOR.

1042. Steady States Produced by Radiation with Application to the Distribution of Atmospheric Ozone. O. R. Wulf. *Phil. Mag.* 17. *pp.* 251–263, *Feb.,* 1934.—Where steady states are produced by the absorption of radiation in very long paths of gas weakly absorbed radiation plays an important rôle because of its ability to produce large amounts of product in very dilute form—that is to say, sparsely but widely distributed. Such cases arise in the atmospheres of planets and stars. In the instance of the ozone of the earth's atmosphere, which in this paper is worked out in some detail as an example, these considerations show that the ozone will not be distributed as a layer, but will be spread out over a considerable range of altitudes. In the case of stellar atmospheres photo-ionisation and photo-excitation should produce in the high altitudes an excess of ions and excited states over that to be expected from the temperature alone. AUTHOR.

1043. Lunar Atmospheric Tide at Buenos Ayres, 1891-1910. S. Chapman and M. Austin. *Roy. Meteorolog. Soc., J.* 60. *pp.* 23–28, *Jan.*, 1934.—The lunar atmospheric tide at Buenos Ayres has been determined from 20 years' data. The annual mean result is $13 \sin (2t + 87^\circ)$ in microbars. The amplitude is unexpectedly low for the latitude of Buenos Ayres, and suggests that the normal lunar tide is modified by local effects. The probable error of the determination is relatively large (4·2 microbars), and on this account it has not been possible to obtain a reliable determination of the seasonal changes in the tide at this station. AUTHORS.

1044. Condensation of Water in the Atmosphere. M. G. Bennett. *Roy. Meteorolog. Soc., J.* 60. *pp.* 3–14, *Jan.*, 1934.—Following an introduction in which the nature of the problem is indicated, the author proceeds to discuss the nuclei in the atmosphere, dealing in turn with their nature, source, properties and growth. The reason that fogs occur in unsaturated air near the ground, while they do *not* occur at times in saturated air there, is considered as perhaps due to the vapour pressure of the nuclei. The behaviour of moisture-laden air at heights above ground is also considered; and the author concludes that for condensation to occur at any point, the water vapour pressure there need not be that of saturated vapour over a plane surface of pure water. The production of rain drops is next dealt with, and after an examination of present knowledge on this subject, it is concluded that further investigation is necessary. The author ends the paper with a series of questions in which are set out the problems yet to be solved before a complete solution can be given to the problem of the condensation of water vapour in the atmosphere. A. E. M. G.

1045. Upper Limit of Cloud and Mist. R. Feige. *Zeits. f. Instrumentenk.* 54. *pp.* 23–26, *Jan.*, 1934.—The upper limit of cloud is investigated either by finding the sharp discontinuity in the moisture content of the atmosphere, or the sudden increase in the intensity of the light which is dimmed inside the clouds. Hygrometers and photoelectric cells are placed in kites and balloons and arranged to transmit, either along wires or by wireless waves, the atmospheric effects to stations on the ground where records are made. H. M. B.

1046. Is Our Weather Changing? Study of Long-Time Temperature Trends. J. B. Kincer. *Monthly Weather Rev.* 61. *pp.* 251–260, *Sept.*, 1933.—In order to determine whether our climate is changing, especially as regards the severity of the winter periods, the author has examined the temperature records from several representative stations throughout the world. The longest records available are used and a system of moving 20-year summations of temperature data are plotted against the time. A large number of graphs is thus obtained. Some of them show a slight fall in the mean annual temperature previous to 1870, but after this date all, with the exception of stations near the equator, show a definite increase, *e.g.*, Philadelphia shows an increase of 2·6° C. between 1844 to 1932. Comparisons between city and landward stations show that the data are not influenced by cities. A series of charts illustrates the trend in the four seasons for some American stations. From 1870 onwards summer indicates a slight decrease in the average temperature, but all other seasons give definite increases. For Washington the average number of days on which occurs frost in spring and autumn is decreasing as is also the average number of days with freezing weather (*i.e.*, continuously below 32° F.) in winter, while the frost free period is lengthening. The mean annual and seasonal temperatures for several stations are given in tabular form. A. E. M. G.

1047. Sky Brightness. H. H. Poole and W. R. G. Atkins. *Roy. Dublin Soc., Proc.* 21. *pp.* 1–8, *Dec.*, 1933.—Describes a method used for measuring the brightness of any portion of the sky vault. The size of the portion actually measured was 59·2 square degrees. The measuring instrument was a Weston photoelectric (rectifier) cell. Diagrams are given showing the brightness on four different days for all angles of altitude from 7½° to the zenith and for angles of azimuth 0° (position of the sun), 30°, 45°, 90° and 180°. J. W. T. W.

1048. Illumination from Sun and Sky. T. E. Aurén. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24 *A.* No. 4. [55 *pp.*], 1933. *In English.* —The illumination from the sun and sky has been measured at Stockholm with photoelectric cells throughout the period 1928–32 apart from a few short breaks and the amount of irradiated light energy determined daily by integration. Daily values are tabulated in terms of the average illumination on a horizontal surface under a clear sky with a solar altitude of 45°. Hourly values are also calculated for the months May–Sept., the vegetation period proper. Values of the illumination are also calculated for different solar altitudes up to 54° for each year. From these mean monthly and annual values of light are obtained for Stockholm and their effect on tree growth discussed. The relative illumination is defined as the percentage ratio of the amounts of light actually irradiated and that possible from a clear sky and daily values are found. These are collected into 10 % groups and their monthly distribution discussed. March is the brightest and December the worst month. The ratios of the total quantity of light to the total radiation and to the hours of sunshine have a strong seasonal variation and the former depends also on cloudiness. The effect of cloudiness is obtained by tabulating the average monthly cloudiness at Stockholm and comparing the values with those for the relative illumination. From the relations established the mean illumination is calculated for four days for a number of places in Norway and Sweden and curves are drawn for equal illumination. Thus it is found that in spring and summer the illumination is much greater in the east than in the west, and Gotland and parts of Norbotten are most favoured. In winter latitude is the predominating factor. R. S. R.

1049. Ultra-Violet Emission Spectrum of the Night Sky. J. Dufay. *Comptes Rendus,* 198. *pp.* 107–109, *Jan.* 3. 1934.—Microphotometric registrations with a quartz spectrograph at Courbon showed about 12 lines or groups of solar lines in the region 4861 to 3101 Å and their wave-lengths and intensities, estimated on an arbitrary scale, are tabulated. Many lines, found also by Sommer, Ramanathan, Vegard and by the author earlier, are also visible. Bands of N_2^+ and N_2^- are found accompanied by other rays of unknown origin which are more numerous and more intense than in the auroral spectrum. In the visible region the bands appear feeble but their intensity changes less and appears relatively greater in the ultra-violet. R. S. R.

1050. Polarisation of Light at Sea. E. O. Hulburt. *J.O.S.A.* 24. *pp.* 35–42, *Feb.*, 1934.—A polarising prism properly oriented was found to darken the sea relative to the sky, to reduce the brilliance of the sun path and to render the horizon more distinct. In bright weather it increased the visibility of objects against the sea background. Attaching polarising prisms to a sextant and to binoculars improved these instruments in certain cases. Measurements of the light of the sea ruffled by a breeze from several hundred yards from the observer out to the horizon several miles away showed that the light was often more, and rarely less, than 2/3 polarised with electric vector mainly horizontal but tilted up under certain conditions, *e.g.*, tilted up 30° for the sun bearing 90° and at 45° altitude. From the observations and theory it came out that the sea light was the light of the sky at about 25° to 35° above the horizon reflected by the sea, the reflecting facets of the sea surface being most frequently at about 15° to the horizontal. The width of the sun path calculated from this was in agreement with the observed width of about 6°, 14° and 18° in moderate weather for the sun at altitudes 10°, 20° and 30°, respectively. The explanation is given of a number of breezy sea reflection phenomena.

AUTHOR.

1051. Autographic Instrument for Vapour Pressure and Specific Humidity. F. Wenk. *Zeits. f. Instrumentenk.* 54. *pp.* 15–19, *Jan.*, 1934.—The apparatus described contains pressure, temperature and humidity elements and continuous registrations of vapour pressure are obtained. The measurements are correct and quantitative. The idea of the instrument is based on the former thermo-hygroscope, and in the present case logarithmic addition of the component factors is made possible. The theory of the action of the instrument is described, this being based on the formula of Magnus for humidity and temperature. Four types are constructed to give respectively (1) vapour pressure for relative humidies (*a*) above 25 % and (*b*) any value, and (2) specific humidity for (*a*) small, and (*b*) any, pressure interval. R. S. R.

1052. Anemometer Little Sensitive to Changes of Wind Direction. A. Martinot-Lagarde. *Comptes Rendus*, 198. *pp.* 338–339, *Jan.* 22, 1934.—The Dines pressure-tube anemograph is modified by retaining the suction part unchanged but the compression part is modified by means of a tube which conveys the total wind pressure to the vane when oscillating in a gusty wind. This pressure remains constant to 0·5 % with angular oscillations of wind direction of ±45°, while the error is 7 % for 50°. This error is reduced by having a second Venturi with an exit section 1·5 times that at entry and an inner tube whose external diameter is relatively much smaller and about one third that of the mechanism. Giblett obtained [see Abstract 3068 (1932)] a difference of pressure of $p=1 \cdot 39$ or $1 \cdot 49q$, while the author obtains a coefficient of 1·52 for wind speeds of 7 to 22 m./sec. and a Venturi diameter of 12 mm. The accessory to the vane used consists of a wind sleeve of muslin, and the central line remains sensibly rectilinear. With a wind speed of 5 m./sec. the sleeve makes an angle with the wind of $< 2^\circ$. The wind sleeve can be readily photographed against the sky. R. S. R.

See also Abstracts 952, 1008, 1019, 1056, 1249, 1360.

SEISMOLOGY.

1053. Propagation of Earthquake Waves. K. Wadati. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 494–497, *Nov.*, 1933. *In English.*—Travel times of P'_1 for $\Delta=150$–180° are given, based as regards shallow focus earthquakes on observations made on the New Zealand earthquake of 1929.VI. 26; for deep focus (100–500 km.) quakes the focal depth was deduced from observations on reflected waves [see Abstract 3746 (1931)]. Similar times for ScS for $\Delta=0-500$ km. are tabulated, and indicate the correctness of 2900 km. as the depth of the earth's core at which these waves are reflected at the marked discontinuity that must exist there. An example of the "focussing" of an sS wave at about $\Delta=23^\circ$ from the epicentre is given. C. A. S.

1054. Propagation of Elastic Waves from a Cylindrical Origin. H. Honda. *Geophys. Mag., Tokyo,* 7. *pp.* 249–256, *Nov.,* 1933.—The propagation of elastic waves diverging from a cylindrical origin in an infinite elastic medium, subjected to the normal stress periodically acting at the surface of a cylinder, is investigated. Numerical values of the coefficients of the amplitude are calculated for special cases. W. A. R.

1055. Effects of Discontinuity Surfaces upon the Propagation of Elastic Waves. Part II. G. Nishimura and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 595–631, *Dec.,* 1933. *In English.*—Continuing the work of the first paper [see Abstract 4426 (1933)] the motion of particles, which arise when a harmonic train of dilatational waves is obliquely incident on the base of a surface-layer overlying a semi-infinite solid, is studied. The surface-layer and the semi-infinite solid are free at their junction to slide over each other as before. The amplitudes of both the horizontal and vertical motions of a particle in the surface-layer vary with the emergence-angle of the incident wave, and they are greatly influenced by the thickness of the surface-layer and the wave-length of the incident wave. Generally, a particle of the lower medium on the common boundary makes an orbital motion, but the particle of the surface-layer on this boundary has only a vertical motion, of which the amplitude is equal to that of the vertical component of the orbital motion of a particle of the lower medium on this common boundary. This result cannot obtain where the boundary conditions are such that the two solid layers adhere. W. A. R.

1056. Barometric Gradients and Earthquakes. W. Inouye and Y. Inaba. *Tokyo Univ. Earthquake Research Inst., Bull* 11. *pp.* 704–713, *Dec.,* 1933. *In English.*—In a previous paper [see Abstract 2776 (1932)] the relation of barometric gradients to earthquakes outside the Kwantô district was examined, and now the relation in this district is investigated. The gradients are of the order of 1 mm. mercury per 100 km. It is doubtful whether barometric gradients at times of earthquakes really do act as a secondary cause, but it is true that the orientation of barometric gradients in a district, where an earthquake occurs, before a severe shock, differs from the orientation afterwards. W. A. R.

1057. Phases of Earthquakes Distant 10,000 km. and Upwards. C. Bois. *Union Géodésique et Géophysique, Travaux Scientifiques, No.* 8. *pp.* 121–149, 1933.—The characteristics, and the differences between the calculated (from Macelwane's tables) and observed times of travel of some or all of the phases P, P'_1, $S_cP_cP_1$, PR_1, PR_2, S_cP_cS, $S_cP_cP_cS$, S, PS, PPS, and SR_1 are tabulated for 44 earthquakes (1922–1928) as recorded at Strasburg distant 10,033–18,067 km.; also the values of the differences $P'_2-P'_1$ for 12 earthquakes, distant 16,011–18,900 km., with for comparison the same differences for 26 distances (146·7–168·6°) as given by Macelwane. (The suffix *c* denotes reflection or refraction at the surface of the inner nucleus, depth 2900 km., P'_1, P'_2 the two P_cP_cP waves.) The results are discussed with reference to deciding the phases likely to give the most accurate position of the epicentre. There is satisfactory evidence for only the surfaces of discontinuity at 50 and 2900 km.; the inner nucleus is probably pasty. C. A. S.

1058. Use of Electric Beat Oscillators in Seismology and in the Study of Dielectric Constants. (Mrs.) A. Hée. *Union Géodésique et Géophysique, Travaux Scientifiques, No.* 9. *pp.* 3–97, 1933.—A beat oscillator is adapted for use with a seismograph by mounting one of the two condensers of the oscillating circuits on the fixed part of the seismograph. When the apparatus receives an impulse, the beat frequency is modified and the instant when this occurs can be observed with precision. An Abraham oscillograph was used to record the amplified beat current on smoked paper. In this form of seismograph the impulse may be made to move either the dielectric of the condenser or one of the condenser plates; in the oscillograph finally adopted the impulses were made to displace one of the plates. Tests were made of the effect of temperature and extraneous vibrations and of extraneous electric fields, and having obtained stable conditions, the form and periodicity of the beat current were found to agree with simple theory so long as the beat frequency was not less than 50 per sec. Finally, two methods were devised for determining the dielectric constant of quartz and a few types of glass, a direct method giving an accuracy of about 3 parts in 1000 and a method of compensation giving an accuracy of 2 %. The dependence of the value of K on the direction of the optical axis of quartz was confirmed, but the values obtained differed from some of the earlier values for quartz. The possibility of using the piezoelectric effect of quartz in geophysical applications is considered, and the paper concludes with a Bibliography of 55 references. J. S. C.

1059. Long Period Horizontal Seismograph. H. Honda, K. Sagisaka and M. Tamura. *Geophys. Mag., Tokyo,* 7. *pp.* 245–247, *Nov.,* 1933. *In English.*—The stationary mass (60 kg.) is suspended by a wire 20·5 m. long; the period can be adjusted up to several minutes, actually one of 65 sec. was used; damping is magnetic, and magnification 5·6. Examples of records are given. C. A. S.

1060. Vertical-Component Seismographs. C. Bois. *Union Géodésique et Géophysique, Travaux Scientifiques, No.* 8. *pp.* 5–120, 1933.—An account is given of the various devices used in constructing vertical component seismographs, with in particular a detailed account of the Strasburg seismograph with 19-ton pendulum for recording both the horizontal and vertical components. The devices for increasing the period are then described, distinguishing cases where the mass is directly connected with the spring support from those in which an arm intervenes, with reference to the Wiechert, Galitizin and (especially) Strasburg instruments, of which last the period has been increased from 0·2 to 1·0 sec. The effects of variation of temperature, and means of overcoming or reducing these are similarly discussed, and the value of elinvar emphasised. A detailed account of the method whereby a 55 % reduction in such variations has been achieved in the Strasburg instrument is given. C. A. S.

1061. Accelerometric Vertical Component Seismograph. M. Ishimoto. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 717–723, *Dec.,* 1933. *In English.*—The cylindrical pendulum weighing 15 kg., is suspended directly from the spring; the natural period is 0·07 sec., slightly increased by the system of three amplifying levers; magnification is 215; damping by air. Diagrammatic and photographic representations are given, as also the method of standardisation and some records. [See Abstract 355 (1932).] C. A. S.

See also Abstract 1248.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1062. Ionisation Balance of the Atmosphere. V. F. Hess. *Gerlands Beitr. z. Geophys. Supplementband,* 2. *pp.* 95–152, 1933.—The author provides a very comprehensive review of the discoveries relating to the various ionisation processes in the atmosphere and the methods by which the number of ions is decreased, and leads on to a statement of the ionisation balance in the various parts of the atmosphere. The following ionisation processes are considered: (1) non-radioactive origin; (2) radioactive substances in the earth's surface; (3) action of γ-rays of radioactive substances in the earth's surface such as (*a*) U — Ra series, (*b*) Th series, (*c*) substances containing K, (*d*) a comparison with observations, (*e*) decrease of γ-radiation with height, and (*f*) γ-radiation over the sea; (4) action of β-rays of radioactive substances in the earth's surface; (5) Ra emanation and its decomposition products in the atmosphere (*a*) near the earth's surface, (*b*) decrease of RaEm content with height, (*c*) RaEm content over the sea and (*d*) seat of RaEm in the atmosphere; (6) ThEm and its decomposition products in the atmosphere; (7) ionising action of RaEm and ThEm and their decomposition products in the atmosphere; (8) cosmic radiation; (9) balance of ionisers over land, sea and the free atmosphere; and (10) atmospheric content of ions and condensation nuclei. The ionic destruction processes considered include the square and linear recombination laws, the recombination of small and large ions and Nolan's empirical law. The ionic balance in the atmosphere is then examined over the land and sea and in the free atmosphere to the upper limits of the troposphere and also ionic relations in the stratosphere. It is concluded that in the troposphere the ionic balance between the calculated and observed ionisation is in good agreement if one states that a homogeneous and harmonious relation is not yet outstanding for the law of ionic destruction. For the lower and upper stratosphere the ionic balance can similarly be explained as a whole, but a direct comparison of observed and calculated ionisation values is not yet possible for this region. R. S. R.

1063. Attempt to Detect Radiation in Thunderclouds. W. A. Macky. *Cambridge Phil. Soc. Proc.* 30. *pp.* 70–73, *Jan.* 31, 1934.—An account is given of attempts to detect radiation in thunderclouds by means of photographic plates attached to balloons. Eleven balloons were sent up and the plates attached to ten were recovered and examined. The result was negative in every case. A small ionisation chamber with quartz condenser intended for detecting radiation in thunderclouds is described. AUTHOR.

1064. Branching of Lightning and Polarity of Thunderclouds. J. C. Jensen. *Frank. Inst., J.* 216. *pp.* 707–748, *Dec.,* 1933.—There is first considered the various mechanisms which have been suggested for the production of thunderstorms, and it is shown that there exists a distinct disagreement on the part of the two main groups of investigators. The present investigation deals with problems relative to polarity of clouds and to direction of field change resulting from a given lightning discharge; also with path of storm cloud, portion of cloud from which discharges come, and with direction of branching. A description of the apparatus and methods employed is given. Typical examples of the lightning photographs obtained are reproduced and fully discussed. In the summary of the conclusions from the investigation it is pointed out that the type of storm with a concentration of negative charge in the front portion agrees best with observational data. A. E. M. G.

1065. Remarkable Lightning Photograph. B. Walter. *Phys. Zeits.* 35. *pp.* 88–91, *Jan.* 15, 1934.—Discussion of a complicated lightning discharge. What appears to be a double flash is explained as two partial discharges along the same path at different instants, revealed by a slight displacement of the camera. Comparison of two of the flashes, one of which strikes earth, the other water, brings the conclusion that the course of the after-flash depends on the conductivity of the material surrounding the spot where the first flash struck. G. E. A.

1066. Progressive Lightning. B. F. J. Schonland and H. Collens. *Roy. Soc., Proc.* 143. *pp.* 654–674, *Feb.* 1, 1934.—Eleven lightning flashes, comprising fifty separate strokes from two separate thunderstorms, have been photographed with a rotating lens camera based upon the design of C. V. Boys. The speed was high enough to permit the study of the propagation of the discharge. The majority of the strokes were found to be double and to consist of a dart-like downward-moving leader stroke, followed immediately upon arrival at the ground by a more intense flame-like upward-moving main stroke. The mean velocity found for the leader strokes was $1 \cdot 1 \times 10^9$ cm./sec. along the tortuous track in two dimensions and $7 \cdot 0 \times 10^8$ cm./sec. in the vertical direction. The length of the dart was found to be less than 54 m. Corresponding mean velocities for the main strokes were $6 \cdot 0 \times 10^9$ cm./sec. and $3 \cdot 8 \times 10^9$ cm./sec. The majority of the strokes were unbranched. Four strongly branched tracks have been examined. The branches always developed outwards from the main channel after the discharge had reached the branching point. They travelled with a velocity of the same order as the main strokes. The leader strokes are shown to be identifiable with electron avalanches and the main strokes with thermally ionised channels. The polarity of the discharges was such as to make the cloud-base negative and the earth positive. AUTHORS.

1067. Magnetic Observations at Scoresby Sound during the Polar Year. J. P. Rothé. *Comptes Rendus,* 197. *pp.* 1057–1059, *Nov.* 6, 1933.—The curves from continuous observations of the magnetic field made at Scoresby Sound indicate a periodicity in the variations of about 28 days in both quiet and disturbed days. During disturbed periods the diurnal variation is very marked at all periods, but in calm periods this variation shows minimum at winter solstice and maximum in July. Comparison is made between results obtained at Scoresby Sound and at the observatory at Val-Joyeux on the variation of the horizontal component showing a maximum at one place corresponding to a minimum at the other. The magnetographs employed have also permitted the fixing, to within a few seconds, of the time of commencement of any disturbance. Further, the results found at the station where these magnetographs are established are shown to be comparable to those obtained on the ice in the fjord, and so indicate that the station is free from the anomalous effects experienced at Cape Stewart. A. E. M. G.

RADIOACTIVITY.

1068. Effective Diameters of Radioactive Nuclei. G. Gamow and S. Rosenblum. *Comptes Rendus*, 197. *pp*. 1620–1622, *Dec*. 18, 1933.—The effective diameter of a radioactive nucleus is defined as the diameter d_0 minus a term containing the atomic number of the nucleus and the azimuthal quantum number of the emitted particle. A relation between the disintegration constant, the speed of the emitted α-particle, and the effective diameter of the nucleus, enables the last named quantity to be determined. The effective diameters of the Ra and Th groups when plotted against atomic weight lie nearly on the same smooth curve, while those of actinium lie on a slightly lower curve. Nuclei which emit more than one group of α-particles have effective radii corresponding to each group. J. E. R. C.

1069. New Type of Radioactivity. Irène Curie and F. Joliot. *Comptes Rendus*, 198. *pp*. 254–256, *Jan*. 15, 1934.—During a further investigation of the positrons emitted from certain elements when subjected to α-particle bombardment, it has appeared that, at least for three elements, this emission constitutes a new form of radioactivity. After bombardment with α-particles from polonium, specimens of these elements continue to emit positrons, even after the polonium has been removed. The decay periods associated with this radiation are given as 3·25 min., 14 min. and 2·5 min. for B, Mg and Al respectively. Many other elements were examined for this effect, but with a negative result, possibly owing to their having a very small decay period. The energies of the positrons are given as $2 \cdot 2 \times 10^6$e.V for Al and $0 \cdot 7 \times 10^6$e.V for B and Mg. The paper concludes with a discussion of the transformations associated with this radiation. **Erratum,** *ibid. p*. 408, *Jan*. 22, 1934. J. E. R. C.

1070. Atomic Weights of Radioactive Substances, Actino-uranium, and Geologic Time. F. Western. *Univ. Pittsburgh, Bull*. 30. *pp*. 295–302, *Nov*. 15, 1933.—Available data for and against the one-isotope hypothesis of the origin of the actinium series, *i.e.*, that it runs $U^{235}_{92} \xrightarrow{\alpha} UY \xrightarrow{\beta} Pa \rightarrow \ldots Pb^{207}_{82}$, and not $U^{239}_{92} \xrightarrow{\alpha} ? \xrightarrow{\beta} ? \xrightarrow{\beta} U^{235}_{92}$, etc. as before (the two isotope hypothesis), are examined. There is no trace of the β-ray emitting elements required by the latter. Assuming, as seems probable, the actinium branching ratio to be 0·03—0·04, the decay constant and half life of U^{235}, deduced separately from bröggerite and uraninite, are in substantial agreement [see Abstract 888 (1932)], as required. So far as it goes the evidence favours the first theory, but more is required. Atomic weights of radioactive elements are most accurately deduced by calculation from those of lead isotopes. C. A. S.

1071. Activity of Materials Exposed to Natural Electric Fields. H. Garrigue. *Comptes Rendus*, 197. *pp*. 1619–1620, *Dec*. 18, 1933.—The ionisation produced by various specimens of metal, rock, etc., which had been exposed to atmospheric conditions was measured with a gold leaf electroscope. After a correction had been made for ionisation caused by penetrating radiation, it was found that the ionisation due to the specimens apparently arose from short life radioactive elements. J. E. R. C.

1072. Occurrence of Elements and Origin of Radioactive Bodies. W. M. Elsasser and K. Guggenheimer. *Comptes Rendus*, 197. *pp*. 1627–1629, *Dec*. 18, 1933.—The suggestion is made that the heavy elements have been synthesised by repeated capture of neutrons and emission of electrons by rare gas nuclei. A primeval terrestrial atmosphere rich in rare gases is imagined, which at some stage in the earth's early history passed through a dense swarm of neutrons. J. E. R. C.

1073. Radioactivity of Samarium. M. Curie and F. Joliot. *Comptes Rendus*, 198. *pp*. 360–363, *Jan*. 22, 1934.—A thick layer of samarium oxalate, $Sm_2(C_2O_4)_3.10H_2O$, examined in a Wilson expansion chamber, is found to emit α-particles at the rate of $7/cm.^2/min$. The path is probably $\not> 1{\cdot}5$ cm.; and the period of samarium about 10^{12} years. The disintegration suggested is $Sm^{148} = Nd^{144} + He^4 + 0{\cdot}003$. [See Abstract 2316 (1933).] C. A. S.

1074. Recoil Atoms in Gaseous Media. L. Goldstein. *Comptes Rendus*, 198. *pp*. 363–365, *Jan*. 22, 1934.—With a negatively charged electrode in an atmosphere of radon and hydrogen the percentage of atoms of Ra-A remaining charged at the end of their recoil path varied from 36 to 32·5 when pressure varied from 140 to 250 mm. Hg; but deducting the activation of the electrode by direct recoil it was 32, as for the rare gases. With bromine at the vapour pressure due to the temperature of the experiment, the percentage was 79, or nearly the same as in air or oxygen (83). [See Abstract 3462 (1933).] C. A. S.

1075. Radium-Uranium Ratio and the Number of Actinouranium Isotopes. A. E. Ruark and F. Western. *Phys. Rev.* 45. *pp*. 69–70, *Jan*. 15, 1934.—The radium-uranium ratio V is given by $E(1-\frac{1}{2}nB)/Z$ where 2E and Z are respectively the numbers of α-particles emitted per sec. per gm. of U or of Ra; B is essentially equal to the actinium "branching" ratio; and n is the number of actinouranium isotopes. Data on V, E, Z and B are considered in order to determine whether $n = 1$ or 2. The results speak strongly in favour of the existence of only one actinouranium isotope. AUTHORS.

1076. Half-Value Period of Uranium II. O. A. Gratias. *Phil. Mag*. 17. *pp*. 491–496, *Feb*., 1934. *Supplement*.—The half-value period of uranium II has been measured and found to be $1{\cdot}7 \times 10^5$ years. The discrepancy between the two most recently determined measurements of the decay constant has been accounted for by using both an electrolytic method combined with a valve amplifier, and an ionisation method using a Lindemann electrometer. AUTHOR.

1077. Release of Ions from Glass and Quartz Vessels under the Action of Radium Rays. A. Fernau. *Phys. Zeits*. 34. *pp*. 899–900, *Dec*. 15, 1933.—The author finds that the conductivity of water contained in vessels of Thuringian glass, Jena glass and quartz increases under the action of the β- and γ-rays from a radium source immersed in the water. Conductivity measurements of H_2O_2 solutions of various concentrations show that the quantity of H_2O_2 produced by the radiation is not sufficient to account for the observed increase in conductivity. The increase is attributed to the release of ions from the walls of the vessels due to the action of the radiation. W. E. P.

1078. Ion Yield in the Decomposition of Ammonia by α-Rays. H. Essex and Dorothea FitzGerald. *Am. Chem. Soc., J*. 56. *pp*. 65–67, *Jan*., 1934.—The ion yield due to ammonia decomposition by α-radiation is found to be 1·09 at 22° C. and 1 atmosphere pressure. J. S. G. T.

1079. Distribution of Small Amounts of Substances between Liquid and Solid Crystalline Phases. Part I. A. Polessitsky. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 394–398, *Jan.*, 1934.—A method for the determination of small quantities of Ba in saturated solutions of $Pb(NO_3)_2$ has been developed by means of radioactive indicators, and applied to the case of the distribution of small quantities of $Ba(NO_3)_2$ between aqueous solutions and crystals of $Pb(NO_3)_2$. The validity of the Nernst law has been established, and the temperature dependence of the distribution coefficients and partition factors investigated. H. H. Ho.

1080. Photographic Representation of Separation of Minute Quantities by Fractional Crystallisation. O. Hahn, H. Käding and R. Mumbrauer. *Zeits. f. Krist.* 87. *pp.* 387–416, *March*, 1934.—Photographs taken at suitable intervals (according to the half-life periods) of the same crystals grown in solutions containing in addition to the main substance (macro-component) Th*B*, Ra*X* (isotopes respectively of Pb and Ra) and Po, show the distribution of these elements (microcomponents) in the crystals. The crystals so prepared may be (*a*) mixed crystals, *e.g.*, $BaCl_2$ and $RaCl_2$ [see Abstract 487 (1932)]; (*b*) anomalous mixed crystals of non-isomorphous components, but behaving as mixed crystals. Thus, crystals of $BaCl_2$ from a solution thereof containing $\mathrm{Th}B\mathrm{Cl}_2^*$ of ordinary $PbCl_2$ contain a far greater ratio of Th*B* (or Pb) than the solution. Similarly Th*B* (or Pb) is greatly concentrated in anhydrous crystals or any alkali halide with NaCl lattice, but not in the hydrated crystals of the same. The Pb appears to form a complex Pb-halogen anion [see Abstract 4359 (1932)] (*c*) The crystals may show internal adsorption. Here the micro-component occurs regularly placed along certain planes of growth characteristic of both micro- and macro-components, *e.g.*, Th*B*, Ra*X*, and Po in crystals of anhydrous K_2SO_4, Rb_2SO_4 and $(NH_4)_2SO_4$ (but not in the hydrated crystals); also in $(NH_4)_2Cr_2O_7$ and $K_2Cr_2O_7$ (but Th*X* is only adsorbed by $(NH_4)_2Cr_2O_7$ if of lamellar structure). Similar effects occur in nature, *e.g.*, gypsum of Tomaschek exhibits phosphorescence only along certain planes. (*d*) The crystals may show accidental enclosures such as of radiocolloids, *i.e.*, aggregates of radioactive molecules adsorbed on dust particles, or of mother liquor. C. A. S.

1081. Complex Radiation Excited in Aluminium by α-Particles. P. Savel. *Comptes Rendus*, 198. *pp.* 368–370, *Jan.* 22, 1934.—When the radiation produced from aluminium by the impact of α-particles from polonium is examined in a high pressure ionisation chamber, containing argon or hydrogen at 25 atmospheres [see Abstract 2920 (1933)] both γ-radiation and neutrons are found to be complex. The γ-radiation (mainly photons) consists of two varieties: with $\mu/\rho_{Pb}=0{\cdot}17$, energy $0{\cdot}55\times10^6$ e.V., and $\mu/\rho_{Pb}=0{\cdot}045$, energy $2{\cdot}10\times10^6$ e.V. Similarly there are two varieties of neutrons the intensities of which are reduced to half by 1·7 mm. and 1·53 cm. of lead respectively, the energy of the more rapid being 2×10^6 e.V. To excite the γ-radiation the minimum energy of the incident α-particles is $3\text{–}3{\cdot}1\times10^6$ e.V.; and for the neutrons $4\text{–}4{\cdot}3\times10^6$ e.V., penetration to the aluminium nucleus being by a resonance level. The softer γ-radiation is attributable to the annihilation of positrons of aluminium [see Abstracts 1318 to 1320 (1934)] the harder to disintegration of the aluminium atom [see Abstract 2889 (1932).] C. A. S.

1082. Calculations on the Range-Velocity Relation for α-Particles and Protons. W. E. Duncanson. *Cambridge Phil. Soc., Proc.* 30. *pp.* 102–113, *Jan.* 31, 1934.—Various calculations on the range-velocity relation of α-particles and protons are given. The results of theoretical and experimental work by recent investigators are considered, and comparison between theory and experiment is made. J. J. S.

1083. Relative Velocities of α-Particles from Radon, Radium A and Radium C′. G. H. Briggs. *Roy. Soc., Proc.* 143. *pp.* 604–617, *Feb.* 1, 1934.—The relative velocities have been measured by the direct deflection method. The probable error is estimated to be 1 in 80,000. The source of α-particles was radon of high purity and low pressure in a small glass chamber provided with a very thin mica window, the correction for which was determined experimentally. AUTHOR.

1084. Action of β- and γ-Rays on Rock-Salt Crystals. P. W. Burbidge. *Cambridge Phil. Soc., Proc.* 30. *pp.* 62–69, *Jan.* 31, 1934.—The paper describes an investigation of the so-called inner photoelectric effect of rock-salt crystals. The photo-current given by a rock-salt crystal which had been first " activated " in the dark by small dosages of β- and γ-rays and then illuminated by blue light was found to decrease exponentially with time. The total charge for a given dosage, field and illumination was found to be constant and amounted to about 1 electron per effective β- or γ-ray in the initial radiation. The variation of the total charge with the applied electric field was investigated. The relationship between dosage and final charge is discussed, and a short description of the observed phenomena in terms of the quantum-mechanical crystal theory is given. W. E. P.

1085. γ-Rays Produced by Passage of Neutrons across Hydrogenous Substances. P. Auger. *Comptes Rendus*, 198. *pp.* 365–368, *Jan.* 22, 1934.—With regard to Lea's suggestion [see *Nature*, 133, *p.* 24, *Jan.* 6, 1934] regarding the formation of deutons, and that the numerous short tracks observed among those excited by neutrons in hydrogen are those of such deutons, it is pointed out that if a proton and neutron unite to form a deuton the latter should move off in almost the direction of the initial motion of the neutron. But this is not the case [see Abstract 2928 (1933) ; though see also Abstract 4858 (1933)]. Measurements of *e/m* by a magnetic field give no indication of the presence of deutons. In view of these and theoretical objections it is suggested that the mass of the neutron is > that of the proton (1·011 or 1·009), the proton being a combination of a neutron and a positron, less mass $=2–4 \times 10^6$ e.V. The impact of a neutron on such a proton could excite the proton in the case of a non-elastic collision, and cause emission of a γ-ray of energy $2–4 \times 10^6$ e.V., whilst the trajectory of the proton would be more inclined to the initial direction of the neutron than in the case of an elastic collision. C. A. S.

1086. γ-Rays of Radium (B + C) and Thorium (C + C′). C. D. Ellis. *Roy. Soc., Proc.* 143. *pp.* 350–357, *Jan.* 1, 1934.—Information about the nuclear level system of certain radioactive bodies can be obtained both from the long range α-particles emitted and from the γ-ray spectra. Particular importance attaches to the comparison of these two methods. Great improvements have been effected recently in the measurement of the energy of the long range α's, and it became necessary to improve also the accuracy of the γ-ray determination. The present communication describes a measurement of the Ra (B+C) spectrum and certain other measurements on the Th (C+C′) spectrum which were necessary to complete investigations already published. [See Abstract 554 (1933).] AUTHOR.

1087. Internal Conversion Coefficients of γ-Rays. J. B. Fisk. *Roy. Soc., Proc.* 143, *pp.* 674–678, *Feb.* 1, 1934.—The internal conversion coefficient of γ-rays has been calculated for the L_1-shell of RaC, assuming the nucleus to radiate the field of a quadripole. The previous K-shell results have been extended, and slight errors in the region of soft γ-rays have been corrected. Limiting values for very soft γ-rays for the K- and L_1-shells, quadripole and dipole, have been obtained. The ratio of internal conversion in the K- and L_1-shells is about 1 : 6·7 for hard γ-rays, and remains nearly constant up to a value of θ ($=mc^2/h\nu$) of 2. The theory predicts very nearly complete conversion in the L_1-shell for the softest γ-rays which could be converted in that shell. AUTHOR.

1088. Radiographic Use of Radium. V. E. Pullin. *Roy. Soc. Arts, J.* 82. *pp.* 307–322; *Disc.*, 323–326, *Feb.* 2, 1934.—After referring in general terms to the production and important properties of γ-rays, the author describes the use of γ-rays to detect flaws in materials and points out the advantages of γ-rays over X-rays for this purpose in certain circumstances. Examples of the practical application of the γ-ray method are given, together with reproductions of radiographs. The process of estimating the position and size of flaws is referred to. W. E. P.

1089. Phenomena Associated with the Anomalous Absorption of High Energy γ-Radiation. Parts II and III. L. H. Gray and G. T. P. Tarrant. *Roy. Soc., Proc.* 143. *pp.* 681–724, *Feb.* 1, 1934.—Evidence has been obtained, when elements are irradiated with high-energy Th C″ γ-rays, of a softer secondary radiation additional to weak Compton scattering, and of the same order of magnitude as the observed anomalous absorption [see Abstract 4385 (1932)]. There appears to be a new type of atomic interaction in which most of the energy is transformed into radiation analogous to γ-radiation of half a million volts energy. The nature of this radiation is investigated by absorption in lead and iron. It is found to be emitted by C, O, K, Cu, Fe, Sn, and Pb irradiated by hard γ-rays of Th C″ or RaC, the proportion of hard radiation increasing for elements of lower atomic number. Absorption curves are obtained, and, for Th C″, are analysed into two monochromatic components. The secondary emission due to RaC was similar to, but not identical with that for ThC″; the hard component appears to be the same, but the soft components differ. Evidence against interpretation as an emission of characteristic radiation by some structural unit of the nucleus is reviewed. In Part III further evidence is given that the secondary emission is really a γ-radiation. The nuclear interaction and total absorption vary approximately as the square of the atomic number. Results are discussed regarding the proportion of γ-ray energy absorbed by a nucleus and emitted as radiation of smaller quantum energy, and data are found for the isotropic distribution of the radiation. A possible explanation of the phenomena on the basis of the positive electron is examined. N. M. B.

1090. Null Method for Radium Measurement. A. Piccard and L. Meylan. *J. de Physique et le Radium*, 4. *pp.* 715–718, *Dec.*, 1933.—The apparatus described consists of two large spherical high-pressure ionisation chambers having a common central electrode connected to a fibre electrometer, the walls of the chambers being maintained at equal and opposite potentials. The first chamber is irradiated by a fixed radium preparation, the second by the unknown radium preparation, the position of which is adjusted so that the fibre remains at zero. The apparatus is calibrated by means of known radium preparations. It is suitable for both precise and rapid measurements. W. E. P.

1091. γ-Ray Ionisation Chamber for Use with D.C. Amplifier. L. F. Curtiss. *Bureau of Standards, J. of Research,* 12. *pp.* 164–172, *Feb.,* 1934.—A description is given of a new type of γ-ray ionisation chamber in which the source is within the central electrode. The chamber is so designed with guard rings that only an annular zone of ionisation about the source of γ-rays contributes to the measured ionisation current. This arrangement yields ionisation currents for average preparations of radium of the order of 10^{-11} A. These currents are readily amplified by a vacuum-tube amplifier so as to be readable on a microammeter. This arrangement has been tested in the Radium Laboratory at the Bureau of Standards and found to give results accurately comparable with the determinations made by means of a gold-leaf electroscope. It possesses the advantages over the electroscope that it is more rugged, more easily read, no blank drift need be taken, and the operator may be at a distance from the γ-ray source during readings. In addition the source is entirely screened by lead when in position for measurement, and sources of all strengths are measured in the same position. The arrangement is particularly suited to the routine standardisation of commercial preparations of radium and radon. AUTHOR.

1092. Neutral Particles of Intrinsic Mass 0. F. Perrin. *Comptes Rendus,* 197. *pp.* 1625–1627, *Dec.* 18, 1933.—The conservation of energy in the β-ray emission from RaE is discussed, including Pauli's hypothesis of the emission of the neutrino, a neutral particle of electronic mass. The author supposes that each emission of β-particle is accompanied by a simultaneously emitted neutral particle of equal momentum and small intrinsic mass μ. The sum of their kinetic energies is taken as being equal to E_0, the energy of the disintegration. A relation is then obtained between E_0 and the kinetic energy of the β-particle. On applying data for E_0 and the average energy of the RaE β-particles, the relation deduced is seen to hold only if the intrinsic mass of the neutral particle is zero. Its velocity must then be equal to that of light, but it would possess a half quantum spin and no electromagnetic field, its properties being intermediate between those of particles and photons. J. E. R. C.

1093. Attempt to Detect a Neutral Particle of Small Mass. J. Chadwick and D. E. Lea. *Cambridge Phil. Soc., Proc.* 30. *pp.* 59–61, *Jan.* 31, 1934.—The authors have examined the radiation from RaE to search for a penetrating neutral radiation. Measurements were made of the ionisation produced in a high-pressure chamber by the radiation from a solution of Ra (D + E + F) after it had passed through lead up to 5·8 cm. in thickness. No indication of any component harder than the Po γ-ray was obtained. This negative result is discussed in connection with the hypothesis of a neutral particle, the emission of which would compensate the energy distribution in continuous β-ray spectra. It is concluded that if such neutral radiation is emitted by RaE it must consist of particles of small mass and zero magnetic moment and would be very difficult to detect. W. E. P.

See also Abstracts 1134, 1258, 1331, 1345.

RADIATION.

ABSORPTION AND TRANSMISSION.

1094. Influence of Adsorption on Spectral Absorption. K. Schaum and K. Maennchen. *Zeits. f. wiss. Phot.* 32. *pp.* 201–221, *Jan.*, 1934.—The Lambert-Beer-law holds for certain coloured colloidal solutions, but not for others, the divergences being due to various chemical and physical causes. The manner in which the spectral absorption is influenced by adsorption is discussed, and a number of particular cases are considered. The experimental work described is classified under the headings: Adsorption of molar-disperse coloured substances on colourless colloidal particles, and adsorption of colloidal coloured substances on colourless colloidal particles (1) with hydrophile organic colloids such as gelatin, agar-agar, carragheen, gum arabic as adsorbents and (2) with hydrophobe inorganic solvents as adsorbents. The data obtained are to be discussed later after more detailed results for certain cases are available. T. H. P.

1095. Photographic Measurement of the Transmission of Fluorite in the Extreme Ultra-Violet. E. G. Schneider. *Phys. Rev.* 45. *pp.* 152–153, *Feb.* 1, 1934.—The measurement of the transmission of a piece of colourless fluorite was made by photographic methods and the results are compared with those obtained with a photoelectric cell for the same crystalline plate. The wave-length range covered was between 1240 and 1600 Å. AUTHOR.

1096. Photoelectric Measurements of the Transmission of Fluorite in the Schumann Region. W. M. Powell, Jr. *Phys. Rev.* 45. *pp.* 154–157, *Feb.* 1, 1934.—The absorption of several pieces of clear, colourless fluorite from Zell in Baden was measured in the Schumann region at ten different wave-lengths between 1600 and 1235 Å. A grating vacuum spectrograph was used with a photoelectric cell taking the place of the photographic plate. The relationship between the intensity of the light entering the cell and the current from the cell was found to be of the form $I = \text{const. } i^{z}$. Z was found for all the wave-lengths used. All intensity ratios were determined with an inaccuracy not exceeding 1 %. It has been possible to distinguish between the light absorbed by the body of the fluorite and that removed by the surfaces. Although every precaution was taken to produce a good polish, the loss of light at the surfaces was much greater than would be expected from Fresnel's law of reflection and the index of refraction of fluorite. AUTHOR.

See also Abstracts 1100, 1148.

COLORIMETRY.

1097. Equal-Energy Filters. R. Davis and K. S. Gibson. *Bureau of Standards, J. of Research,* 12. *pp.* 263–267, *Feb.*, 1934.—Two filters have been prepared similar to other Davis-Gibson filters, which when combined with an illuminant at 2848 K give the colour of the so-called equal-energy stimulus. One of these has been designed on the basis of the O.S.A. observer, the other on the basis of the I.C.I. observer. Spectrophotometric and colorimetric data are given. [See Abstract 4867 (1933).] AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1098. Thermal Variation of Magnetic Birefringence and Dispersion of Ethy Phenylsuccinate. R. Lucas, M. Schwob and A. Goldet. *Comptes Rendus,* 198. *pp.* 72–74, *Jan.* 3, 1934.—The thermal variation from –6° to 107·5° in the magnetic birefringence, and its dispersion between λλ 5461 and 4358 Å of ethyl phenylsuccinate indicate the presence of at least three isomerides, the birefringence of at least one of which is negative. [See Abstract 4049 (1933).] C. A. S.

1099. Magneto-Optical Dispersion of Organic Liquids in the Ultra-Violet Region of the Spectrum. Part VII. Magneto-Optical Dispersion of Isobutyl Formate, Methyl Butyrate and Ethyl Malonate. R. H. Lavery and E. J. Evans. *Phil. Mag.* 17. *pp.* 351–369, *Feb.,* 1934. *Supplement.*—From an analysis of the observed magneto-optical rotations and refractive indices of the three liquids studied, it is shown that the magneto-optical dispersion can be represented by an equation of the type $\delta = \frac{K}{n} \frac{\lambda^2}{(\lambda^2 - \lambda_1^2)^2}$, involving one absorption band of wave-length λ_1 in the Schumann-Lyman region. The constants K and λ_1 vary with the liquid. The refractive index n fitted an equation of the type $n^2 - 1 = b_0 + \frac{b_1}{\lambda^2 - \lambda_1^2}$ where λ_1 had the same value as for the magneto-optical dispersion formula. From the values of K and b_1, a deduction was made of e/m as follows :—

isobutyl formate $e/m = 0{\cdot}99_4 \times 10^7$ e.m.u.
methyl butyrate $e/m = 0{\cdot}97_6 \times 10^7$ e.m.u.
ethyl malonate $e/m = 10{\cdot}93_8 \times 0^7$ e.m.u.

These low values are in agreement with those obtained by other investigators for different substances. [For Parts V and VI see Abstracts 3491 and 3492 (1933).] W. S. S.

See also Abstract 1125.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1100. Absorption and Fluorescence of Solutions of Phenanthrene. E. Titeica. *Soc. Romåne., Bul.* 35. *pp.* 149–155, *Nov.–Dec.,* 1933. *In French.*—The absorption spectrum of phenanthrene in alcohol consists of several distinct regions. For very weak concentrations there are two broad bands with maxima at 2420 and 2515 Å. For slightly larger concentrations these two bands fuse into a very wide one and at the same time appear a series of faint diffuse bands between 2650 and 2950 Å. Finally, as the concentration is further increased a number of fine bands appear. A table of their wave-lengths is given. The measurements confirm an observation of Henri that some of the bands have frequencies which are multiples of an infra-red frequency 1400 cm.$^{-1}$ The positions and relative intensities indicate that these bands are one of the vibration systems of the first electronic state. The fluorescent spectra in solutions of ethyl alcohol, excited by Hg vapour light has been studied for different concentrations. As the concentration increases from 0·01 % to 0·43 % the spectrum contracts. Spectrophotometer curves are given for 4 different concentrations. It appears that the contraction of the spectrum is simply due to absorption by the solution itself. J. E.

1101. Luminescence of Minerals in Relation to their Origin and Generation. S. Kreutz. *Acad. Polonaise Sci. et Lettres, Bull.* 4–8 *A. pp.* 215–225, *April–Oct.*, 1933. *In French.*—A classification of fluorite, apatite, topas and calcite showing place of origin, colour, colour of luminescence, relative intensity and visible spectrum extension. J. E.

1102. Natural Thermoluminescence of Minerals and Stones. A. Köhler and H. Leitmeier. *Zeits. f. Krist.* 87. *pp.* 146–180, *Jan.*, 1934.—An encyclopædic survey of thermoluminescent minerals with a large Bibliography. The authors conclude that the hope of mineralogists of allocating and classifying minerals by means of this phenomenon is not encouraged by a study of the facts, although it is often possible to draw valuable conclusions as to the manner of genesis of certain compounds. In general it may be said that quite young minerals show better thermoluminescence than old ones and that in very ancient stones there is a weakening again. The relationship to radioactive content or neighbourhood is complex and obscure. J. E.

1103. Thermoluminescent Spectra of Fluorites. Part II. E. Iwase. *Inst. Phys. Chem. Research, Tokyo, Sci. Papers No.* 473. *pp.* 22–33, *Dec.*, 1933.—In a previous paper [see Abstract 590 (1934)] the author pointed out that the bands of thermoluminescent fluorite may be divided into two classes such that a definite relation exists between their frequencies (a constant frequency difference between members of each). The same relations are found to exist in the thermoluminescent spectra. induced by X-rays in samples in which the natural emission has been destroyed by heating. It is found, however, that in this case, one group called α is very much stronger than in the natural emission, and that there is a marked selective temperature effect. Similar results were obtained with fluorites from Wilberforce and Canada, and from Ishigure. In the case of a green fluorite from America and a violet fluorite from Manchuria exposure to X-rays brings out bands not emitted by the natural crystals and belonging to the α-group. It thus appears that exposure can develop centres not present in the natural substance. The paper is illustrated with numerous spectra and photometer curves. [See following Abstract.] J. E.

1104. Thermoluminescent Spectra of Fluorites. Part III. E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 479. *pp.* 153–161, *Jan.*, 1934. *In English.*—The thermoluminescence spectra both of the natural specimens and those exposed to X-rays after heating to eliminate the natural luminescence are identical for all 3 fluorites examined. Eleven bands are observed: those longer than $0\cdot384\mu$ are attributed to terbium; those in the ultra-violet to gadolinium. The four bands in the long wave region are observed, as usual, to be very intense in the spectrum of the restored luminescence as compared with the natural luminescence. The paper is illustrated with spectra and photometer curves. [See preceding Abstract.] J. E.

1105. Photoluminescence of Soda and Potash. A. Grumbach and (Miss) M. Ribaillier. *Comptes Rendus,* 198. *pp.* 70–72, *Jan.* 3, 1934.—The authors find the luminescence due to the presence of formate and carbonate and the spectra dependent on the proportion of these impurities: prolonged calcination destroys the luminescence and this is not restored by re-hydration. Heating to fusion and cooling greatly enhances the intensity of fluorescence. The addition of formate to a hydrate gives after heating a fluorescent substance. Blue or green fluorescence is associated with appreciable amounts of organic salt, while yellow fluorescence indicates carbonate impurity. It is hoped to co-ordinate chemical analysis with the fluorescent spectra. J. E.

1106. Fluorescence and its Use as a Method of Testing and Analysis. J. Grant. *Nature*, 133. *pp.* 124–126, *Jan.* 27, 1934.—A semi-popular survey of some of the uses of fluorescence. The various types of ultra-violet lamp are briefly discussed. The widening field in which the fluorescence excited by ultra-violet light may be used is indicated. Examples are given such as the identification and estimation of alkaloids and dyes, the examination of plant-structure and in criminological and museum work. Three photographs show the application of fluorescence tests to the distinguishing of yellow dyed papers which appear identical in daylight, to the exposure of a forgery and to the distinction between five different rhubarbs. Reference is also made to the use of fluorescence in food examination, in biology and in various industries. J. E.

See also Abstract 1108.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1107. Young's Experiment with Newton's Rings. W. W. Sleator and A. E. Martin. *J.O.S.A.* 24. *pp.* 29–30, *Feb.*, 1934.—Young's experiment, in which interference fringes are produced between a lens and a plate of different refractive indices, with oil between, has been repeated, but an anomalous result was found in that the central spot was dark instead of light. Repolishing of the plane surface restored the light central spot, the effect being due apparently to the influence of outer layers on the phase of reflected light. W. D. W.

1108. Continuous Spectrum in the Light Scattered by Glycerin and other Liquids. O. H. Howden and W. H. Martin. *Roy. Soc. Canada, Trans.* 27. *pp.* 91–96, *May*, 1933.—Organic liquids are found to possess, in addition to their Raman spectrum, a continuous spectrum which is often strong enough to mask the weaker Raman lines. The evidence available tends to show that the continuum is due to an impurity, and a test of this is made with glycerin. It is found that successive recrystallisations greatly reduce the intensity of the continuum, but that irradiation of the purified sample brings out the continuum in its original strength. It is concluded that the continuous spectrum in the light scattered by glycerin is due to a fluorescent impurity, produced by a photochemical decomposition caused by the mercury line 4047 Å, which will fluoresce when excited by 4358 Å. A. H.

1109. Particle Size and Concentration in Opal Diffusing Glasses. C. Dunbar. *Soc. Glass Technol., J.* 17. *pp.* 411–432, *Dec.*, 1933.—The average particle size and concentration in a number of opal glasses have been determined experimentally by means of a high-power microscope. The way in which these quantities vary through the thickness of a glass has also been investigated. The diffusing properties of the glasses have been measured photometrically and the average size and concentration of the particles in the glasses deduced from the theoretical equations of Ryde and Cooper [see Abstract 3042 (1931)]. A comparison has been made of the theoretical and experimental results, and it is shown that over the range of particle size considered, the theory is in good agreement with experiment. AUTHOR.

1110. Fine Structure of Rayleigh Radiation. W. Ramm. *Phys. Zeits.* 35. *pp.* 111–113, *Feb.* 1, 1934.—Monochromatic light from a zinc arc (λ 4680) scattered at 180° in toluene, CS_2, and CCl_4 was photographed through 16 and 33-step echelon gratings [see Abstract 2874 (1932)]. The results show the pair of lines shifted towards greater and lesser λ by amounts required by the heat-wave theory equation $d\lambda = + 2\lambda(v/c)\sin\theta/2$, where v and c are respectively the velocities of sound and light in the medium concerned, and θ the angle of scattering. No scattered lines of higher order, as reported by E. Gross [see *Nature*, 129, 722, 1932] were observed, only a continuous background of intensity increasing with the molecular anisotropy of the medium [see Abstract 1081 (1933)]. C. A. S.

1111. Coherence Characteristics of Emitted and Scattered Radiation. H. Schilt. *Helv. Phys. Acta*, 7. 1. *pp*. 83–107, 1934. *In German*.—From the field-strengths calculated by wave mechanics the expression for the intensity is obtained and hence the coherence characteristics determined. The scattered radiation is first dealt with without consideration of the damping of the radiation. The damping of the radiation is next considered in certain special problems. The emitted, the scattered and specially the resonance radiation is dealt with. J. J. S.

See also Abstracts 1145, 1152, 1250, 1308.

PHOTOCHEMISTRY.

1112. Action of Ultra-Violet Radiation upon Glycocoll. V. Henri, C. Weizmann and Y. Hirschberg. *Comptes Rendus*, 198. *pp*. 168–170, *Jan*. 8, 1934.—Aqueous solutions of glycocoll have their electrical conductivity raised by ultra-violet radiation and their pH increases. Ammonia is liberated in amount sufficient to account for these effects. CO is also formed. A. S. C. L.

1113. Law for the Curves of Blackening by Mixed Colours. A. van Kreveld. *Zeits. f. wiss. Phot.* 32. *pp*. 222–230, *Jan*., 1934.—It is usually assumed that the blackening curves of a photographic negative emulsion for mixtures of monochromatic lights are additive, but the actual relationship is not so simple since, for instance, the curves for the different colours are not of the same form and the manner of the summation is not certain. In the author's experiments, use was made of a red light of 6500 Å (spectral breadth 100 Å.) and a violet light of 4500 Å. (spectral breadth 50 Å.), acting together for the same time (1 min.). The energy-ratio between the quantities of light falling on the plate, measured pyrometrically, were $E_r : E_v = 25 : 1$. Various plates were used but some proved unsuitable owing to low sensitiveness to red light, etc. For the distance $A = 1$ (intensity $I = 1$) from the lamp, r ergs of red light and v ergs of violet light fall on the plate. For a definite blackening S, the separate and combined intensities are I_r, I_v and I_{r+v}, and the quantities of energy necessary are $I_r \times r$, $I_v \times v$ and $I_{r+v} \times r + I_{r+v} \times v$. From these it follows that $1/I_{r+v} = 1/I_r + 1/I_v$ (i). This formula is in agreement with the experimental measurements, the slight deviations being unsystematic and within the limits of experimental error. The form of equation (i) depends on the system of co-ordinates chosen and a more general relation is deduced as follows. If the total red, total violet and total (red + violet) energies are respectively E_r, E_v and E_{r+v}, the last being composed of a red constituent E^r_{r+v} and a violet constituent E^v_{r+v}, it is shown that $E^r_{r+v}/Er + E^v_{r+v}/Ev = 1$. Thus, in the mixture, any quantity of red-energy may be replaced by E_v/E_r times as much violet-energy without the blackening S being influenced. This law is valid for all blackenings within the region investigated, and allows the curves for the mixed colours to be calculated from the separate curves for the monochromatic components. T. H. P.

1114. Hauszer's Unpublished Photochemical Experiment. W. Kossel. *Zeits. f. techn. Physik*, 15. 1. *pp.* 23–25, 1934.—Describes the results obtained upon repeating an experiment carried out by W. Hauszer in 1914 but not previously published. A plate, moistened in distilled water, has two different electrodes placed in contact with it, and a p.d. of 10 volts is applied to the electrodes for 10 min. The plate is then exposed so as to obtain, upon development, an average blackening of the unaffected parts. After development and fixation a transparent part is obtained where the anode has been in contact, the part in contact with the kathode showing a much greater blackening. The light sensitivity of the plate is thus increased at the kathode and decreased at the anode by the passage of a weak electric current through the emulsion, and comparative experiments show that these results are determined by the distribution of Br ions in the emulsion. R. C. F.

1115. Photographic Emulsion: Stability of Finished Plates. B. H. Carroll, D. Hubbard and C. M. Kretchman. *Bureau of Standards, J. of Research*, 12. *pp.* 223–230, *Feb.*, 1934.—The changes occurring in finished photographic plates on storage appear to be the result of continued after-ripening. The results are discussed with respect to variables known to affect this process. Existence of a critical region of bromide ion concentration is demonstrated and shown to be consistent with predictions from the silver ion-gelatin equilibrium. Formation of fog by adding acid to ammonia-process emulsions is confirmed and given a new explanation. AUTHORS.

1116. Solarisation of Photographic Plates. A. Smakula. *Zeits. f. Physik*, 87. 3–4. *pp.* 231–237, *Dec.* 23, 1933.—The solarisation of AgBr plates is found to be dependent upon the wave-lengths and exhibits a maximum at 400 mμ. The same wave-length dependence is given by the darkening curves in the normal exposure region. This selective effect of the wave-lengths at 400 mμ is explained by the different penetrations of the various wave-lengths together with the absorption of Br at 400 mμ, while the solarisation itself is opined to be due to the re-formation of AgBr molecules by the activated Br atoms. H. H. Ho.

1117. Photographic Exposure Meters. B. Lange. *A.T.M.*3. *T*4–5. *Jan.* 31, 1934.—The exposure time is defined principally by the sensitivity of the photographic plate and by the brightness of the picture produced on it, true exposure time being the shortest time which will allow of working on the straight part of the blackening curve of the plate in use. Meters to determine the exposure time have had to be produced owing to the unsuitability of the eye for this purpose. They can be divided into three main groups—optical, chemical, and photoelectric meters—and a number of different exposure meters are briefly described under those three main headings. R. C. F.

1118. Actinity Determination of Photographic Light Sources. O. Reeb and K. Jacobsohn. *A.T.M.*3. *T*3. *Jan.* 31, 1934.—Briefly summarises the data already published on the actinity of photographic light sources. After a discussion of the actinity of light sources in which it is stated that the actinity can be given for a definite photographic layer, the paper deals with definitions and methods of actinity measurement, the quantities defined being relative actinity, actinic intensity, watt actinity, gramme actinity, and actinic surface brightness. R. C. F.

See also Abstracts 876, 1020, 1108, 1119, 1120, 1144, 1179.

PHOTOMETRY.

1119. Portable Ultra-Violet Intensity Meter. W. W. Coblentz and R. Stair. *Bureau of Standards, J. of Research,* 12. *pp.* 231–237, *Feb.,* 1934.—A description is given of the construction and performance of a portable ultra-violet intensity meter, consisting of a photoelectric cell (of titanium, uranium, cadmium, etc.), a balanced amplifier circuit, and a comparatively insensitive micro-ammeter. A means is described for testing the constancy of the sensitivity of the amplifier. It is found that, after preliminary operation for 5 to 10 min. to attain temperature equilibrium in the amplifier tubes, there is no fluctuation in the zero scale reading of the micro-ammeter either when testing the amplification sensitivity of the instrument, or when making measurements of ultra-violet intensities of the sun and of artificial sources, by means of the photoelectric cell. The indicator response (scale reading) was found linear within the accuracy of the micro-ammeter used. Owing to the selective wave-length response of the photoelectric cell, this device, like all selective radiometers, is calibrated in absolute value, by means of the standard balanced thermopile and filter radiometer (" differential actinometer ") [see Abstracts 991 and 5308 (1932)]. AUTHORS.

1120. Photometric Photographic Studies. E. Lau and J. Johannesson. *Zeits. f. techn. Physik,* 14. 12. *pp.* 559–564, 1933. *From the Reichsanstalt.*—It is shown by photographing a distant point source through a plate of diffusing glass placed at the camera objective, that the intensity of illumination at any point in the diffuse image falls off exponentially with the scattering angle, *i.e.,* the angle subtended at the objective by the line joining the centre of the image, to the point concerned. Replacing the diffusing glass with a glass grating ruled with parallel lines spaced at random, an approximately linear decrease of intensity in the diffuse image in a direction at right angles to the ruling is obtained. It is shown how these intensity distributions can be used in stellar photometry, and in testing photographic shutters. By photographing the exponential intensity distribution and photometering the negative, a curve representing the properties of the emulsion is obtained, which shows in a different way the same facts as the H and D curve. The curve is used in a discussion of the optimum exposure time for revealing detail, and for copying. A final section deals with the character of the light scattering obtained by illuminating in various ways developed negatives of different densities, the original exposure being by visible, X-ray or α-particle radiation. Conclusions are drawn as to the distribution of the different grain layers in the negative. W. S. S.

1121. Geiger-Müller Counters for Light Measurements. K. W. Hausser and K. H. Kreuchen. *Zeits. f. techn. Physik,* 15. 1. *pp.* 20–23, 1934.—The properties of Geiger-Müller counters for the detection of weak monochromatic radiation in the region 254–400 $m\mu$ were investigated. The action depends upon photoelectric emission from the metal of which the tube is made ; experiments were done for various metals and for various gas-fillings. The preparation of the counters is described.

It is necessary to be able to vary light intensities in ratios up to $10^8 : 1$; a system of quartz reflectors was used for the purpose. The mercury spectrum was used, and great care was taken to avoid contamination of the monochromatic radiation with stray light. The photoelectric efficiency of the counters made of the different metals was found to be in accordance with expectations. D. H. F.

1122. Measurement of Feeble Illuminations by Means of a Photoelectric Cell. E. Gambetta. *Comptes Rendus*, 198. *pp*. 342–344, *Jan*. 22, 1934.—The essential feature of the circuit is the use of the filament-anode space of an electrometer valve to serve as coupling resistance between the photoelectric cell and an electrometer valve used as amplifier. By varying the filament current in the resistance valve the effective resistance can be varied over very wide limits. For a given light flux on the photoelectric cell, the resistance valve is adjusted to give a convenient indication of the galvanometer in the amplifier valve anode circuit, and in this way light fluxes from 10^{-9} to 10 lumens can be dealt with. By balancing out the average current through the galvanometer, variations of the light flux of the order of 0·01 % are detectable throughout the range. A limit to the sensitivity obtainable is set by the time period of the circuit. W. S. S.

1123. Photographic Photometry Based on Scattering. J. Brentano, A. Baxter and F. W. Cotton. *Phil. Mag.* 17. *pp*. 370–397, *Feb*., 1934. *Supplement*.—The intensity of the light scattered by the silver particles of an exposed and developed photographic film is determined by the density and hence by the intensity and duration of the initial exposure. Thus by measuring the light scattered by the film a method of photographic photometry is obtained which is specially suited to the accurate determination of small densities. Measurements were made of the change in intensity of the scattered light for different angles of scattering, for light of different colours and for coarse and fine grain emulsions of different densities. Best conditions were obtained by determining the scattering at scattering angles between 6° and 15° for red light and with fine grain emulsions. A scattering microphotometer is described with which curves relating scattered intensity to exposure for X-rays were obtained. For small densities the curves were accurately linear, and much smaller densities could be evaluated than by the usual absorption methods. A search for a threshold exposure at which X-rays just failed to produce a photographic effect failed to reveal a finite threshold value. The use of the method in evaluating X-ray reflections from powders, and in measuring Laue spots, is described. W. S. S.

1124. Automatic Photoelectric Photometer. E. B. Moss. *Phys. Soc., Proc.* 46. *pp*. 205–213, *March* 1, 1934.—A precision photoelectric photometer based on principles capable of wide application and operated from a.c. mains is described. It is a flicker instrument but the simple shutter is on the spindle of a synchronous motor driven from the same supply as an a.c. valve bridge. This is connected to an emission type photo-cell, and gives a directional output which automatically moves the neutral density wedge to the position of balance which is shown by a pointer. The wedge position is controlled electrically, being mounted on a galvanometer movement devoid of mechanical control. A description of a densitometer for liquids is given. AUTHOR

See also Abstracts 1047, 1048, 1097, 1118, 1359, 1360, 1361.

POLARISATION.

1125. Photoelectric Measurement of Natural and Magnetic Rotatory Dispersion in the Ultra-Violet. G. Bruhat and A. Guinier. *J. de Physique et le Radium,* 4. *pp.* 691–714, *Dec.,* 1933.—Mainly a connected and more detailed account of work already published [see Abstracts 204 and 1013 (1933), 152 and 170 (1934)], but with the following (chief) additions or corrections: dispersion of saccharose, additional data for λλ 5461–2481, m being defined as $[\alpha]_\lambda/[\alpha]_{4358}$, instead of $[\alpha_D]/[\alpha_\lambda]$ as in the former paper; the formula for dispersion is $[\alpha_{BG}] = 21685/(\lambda^2 - 0{\cdot}02078) + 0{\cdot}027/(\lambda^2 - 0{\cdot}059)$. Verdet's constants for heptene and heptinene are corrected to 1·475 and 1·557 respectively; m (here $= \rho_\lambda/\rho_{4358}$) for heptane, heptene, and heptinene are given by $m = 0{\cdot}2346\lambda^2/n(\lambda^2 - 0{\cdot}02248)^2$; $0{\cdot}2274\lambda^2/n(\lambda^2 - 0{\cdot}01505)^2$, and $0{\cdot}2295\lambda^2/n(\lambda^2 - 0{\cdot}01466)^2$ respectively. C. A. S.

1126. Absolute Configuration of Optically Active Compounds. W. Kuhn and K. Bein. *Zeits. f. phys. Chem.* 24. *Abt.B.* 5–6. *pp.* 335–369, *Feb.,* 1934.—For optically active compounds of the type of dipyroracemic acid-penta-erythritol and $K_3[Co(Ox)_3]$ (Ox = oxalic acid) a diagrammatic model has been constructed which allows of the calculation of the optically active behaviour, especially in the region of definite absorption bands (in the near ultra-violet or in the visible spectrum). It is assumed that the coupling forces which arise from the manifestation of the optical vibrations between the parts of the molecule can be determined, at least as regards sign, from the polarisability of the separate parts of the molecule and the electric moments occurring in the neighbouring parts. For the compound $K_3[Co(Ox)_3]$ the calculated optically active relationships are in agreement qualitatively and to some extent quantitatively with the experimental results. T. H. P.

See also Abstracts 1050, 1316.

RADIATION, EMISSION.

1127. Radiation Measurements with a Gas Radiometer. M. Plotnikow, Jr. *Acta. Physica Polonica,* 2. 3. *pp.* 335–356, 1933. *In German.*—Describes a radiometer consisting of a blackened sheet of metal or other material supported in a gasfilled enclosure analogous to a gas thermometer. When radiation falls on the blackened sheet a portion (actually about 1 %) of the energy received is converted into molecular kinetic energy and is measured as increase of volume of the gas in the enclosure. The author has, with this instrument, compared the radiations from various sources of radiant energy, including a black-body, at various temperatures. Other applications are described. J. W. T. W.

1128. Spectral Emissivities of Tungsten-Molybdenum Alloys. P. N. Bossart. *Univ. Pittsburgh, Bull.* 30. *pp.* 59–64, *Nov.* 15, 1933.—Tubular filaments of the alloys and of the pure metals were made by extruding a paste containing tungsten and molybdenum powders, mixed in the desired proportions, through a die. Small side holes were then pierced with a fine wire, and after sintering and polishing, the filaments were mounted in lamp bulbs which were subsequently evacuated. The filaments were heated to the test temperature by passage of a current, and the temperatures of the external surface and the internal surface seen through the side holes, were determined using a disappearing filament optical pyrometer. From these measurement the emissivity could be derived (Worthing's method). Data are given for the emissivity at $\lambda = 0{\cdot}66\,\mu$ for tungsten, molybdenum, and alloys containing respectively 25, 62·5 and 87·5 % (by weight) of tungsten, for a number of temperatures in the range 1300° to 2800° K. The emissivity of the alloys exceeded by 10 % at 2200° K. to 20 % at 1300° K. the value calculated assuming the alloy to be merely a mechanical mixture of its components. Variations were observed in the emissivity of the alloys after ageing, which are attributed to enrichment of the surface in tungsten owing to the higher rate of evaporation of molybdenum. W. S. S.

1129. Cosmic and Solar Activity. Observations of Cosmic Rays at Scoresby Sound during the Polar Year. A. Dauvillier. *Comptes Rendus*, 197. *pp.* 1741–1744, *Dec.* 26, 1933.—For the measurements, two types of apparatus were employed (*a*) a Wulf-Kolhörster instrument, (*b*) a silver instrument arranged for high pressures. The effect on the observations of change in magnetic latitude from Brest to Scoresby Sound is small whereas the barometric variations at the station cause considerable fluctuations. A comparison of the coefficients of absorption in zinc and in air indicates the constancy of absorption of cosmic rays in matter. An absolute measurement of the intensity gives I = 2·81 pairs of ions. Calm periods lasting for days and variations which have no connection with the magnetic, auroral, and solar activities [see Abstract 568 (1934)] occur. Consideration is given to the theoretical interpretation of the cosmic rays and other phenomena. Reasons for the variation of certain phenomena, *e.g.*, the aurora, and the non-variation of others, *e.g.*, the cosmic ray intensity, with solar activity, are given, and their probable causes unravelled. A. E. M. G.

1130. Distribution of Direction of Cosmic Radiation. W. Kolhörster and L. Tuwim. *Gerlands Beitr. z. Geophys. Supplementband*, 2. *pp.* 238–302, 1933.—A discussion is given of the results hitherto obtained regarding the distribution of direction of cosmic rays. These show that the mean systematic distribution supports the following hypotheses: (1) The cosmic radiation is on the average uniformly distributed in space. (2) Each elementary bundle of parallel rays is, without appreciable deviation through scattering in the atmosphere, absorbed according to the simple exponential law. For the two hitherto used methods of quantitative measurement—ionisation chamber and counting tube—the following differences appear: Ionisation chambers allow direction measurements only through artificial screening off with shields. They have given hitherto a preponderance to the intensity of radiation from directions near the zenith with a maximum at about 20–25° distance from the zenith. Hence are calculated 2–3 times higher values of the absorption coefficient than those determined by the latest water absorption measurements for the corresponding depth. Thus it is to be assumed that the distribution of direction determined by ionisation chambers only gives the order of magnitude. Disturbances due to the screening occur. With a counting tube it is possible to get the distribution of direction without artificial shielding. There are found a considerably greater number of inclined cosmic rays than would be expected from the earlier determinations of direction with ionisation chambers. The maximum of the number of particles through a horizontal surface is situated at sea level at 35°, and the maximum of the ionisation effect calculated from this at 42°, or about 20° further from the zenith than with ionisation measurements. It is especially significant that at sea level only 8 % of the ionisation of cosmic rays originates from a circle of 30° diameter around the zenith while the other portion of the vault of the sky furnishes 92 %. The absorption coefficients calculated from this distribution agree well with those from measurements under water, so that the distribution of direction measured with a counting tube comes near to the actual conditions. J. J. S.

1131. East-West Effect of Cosmic Radiation. A. Ehmert. *Phys. Zeits.* 35. *pp.* 20–25, *Jan.* 1, 1934.—The theory of Lemaître and Vallarta assumes corpuscular cosmic radiation components which in higher latitudes are incident unhindered but in the neighbourhood of the equator in consequence of their deflection in the earth's magnetic field cannot reach the earth's surface so that there smaller intensity is found. As a consequence of the theory there is to be expected in the zones in which the radiation intensity changes with the latitude an east-west asymmetry. This was investigated at a height of 3000 m. on the Zugspitze in Bavaria as the effect increases with the height. Four connected counting tubes were used to observe the coincidences. The results of the observations are given. From these it is concluded that already at the place of origin of the secondary electrons registered the primary radiation producing the same must have a marked distribution of direction which passes over into the intensity of the secondary radiation. It may be assumed that the negative components found are connected with secondary electrons and the positive components with corpuscular radiation originated outside the earth's atmosphere. J. J. S.

1132. Distribution of Low-Energy Cosmic Rays in the Atmosphere. W. E. Danforth and M. R. Lipman. *Frank. Inst., J.* 217. *pp.* 73–78, *Jan.*, 1934.—Coincidence experiments with two thin-walled Geiger-Müller counters lead to the conclusion that the energy spectrum of cosmic ray secondaries extends down to at least 5×10^6 e.V, and that the intensity in rays per unit solid angle per cm.^{2} per sec., between 5×10^6 and 10^7 e.V, is about 1/8 of the total intensity above 10^7 e.V. F. C. C.

1133. Present Knowledge of Cosmic Rays. P. Auger. *J. de Physique et le Radium*, 5. *pp.* 1–5, *Jan.*, 1934.—This paper is a summary of present knowledge of cosmic ray phenomena. The experimental methods—the use of ionisation chambers, Geiger-Müller counters and Wilson cloud chambers—are outlined and a comprehensive summary of all results so far obtained is given. The interpretation of the results is discussed, including the question of whether the primary radiation entering the earth's atmosphere is electromagnetic or corpuscular. It is shown that the corpuscular theory fits the experimental results better, though there are still some difficulties. D. H. F.

1134. Ionisation by Cosmic-Ray Particles and Swift β-Particles. G. L. Locher. *Frank. Inst., J.* 217. *pp.* 39–58, *Jan.*, 1934. *Paper read at the Cosmic-Ray Symposium A.A.A.S. meeting, Atlantic City, N.J., Dec.*, 1932.—The estimate of the specific ionisation along cloud tracks had previously been made by counting the number of droplets, each of which was supposed to indicate an ion or ion-pair. It now appears that such estimates are unreliable because of the frequent production of dense ion-clusters whose drops are too close together for resolution. These clusters are believed to be the result of the generation and immediate photo-electric absorption of soft X-rays in the gas, following the passage of a particle through it. The clusters (1) increase in number with the atomic number of the gas, (2) fall into distinct groups of equal energy. The energies spent in forming these characteristic clusters correspond to characteristic energy transitions of the atoms of the gas. The branches generally arise from the atom in which the radiation is generated, since the absorption coefficient of a parent-atom for its own radiation is nearly unity. Other implications of such a radiation-branch process are: (1) The radiation may escape; a bend occurs in the track corresponding to the momentum lost; it is usually impossible to distinguish the effect from a nuclear deflection. (2) Momentum need not be conserved in a manner evident from the energies and deflections of tracks since the energy may spend a short time as potential energy. (3) The apparent discrepancy between the values of the specific ionisation along cosmic ray tracks as measured by the electrical counting and condensation methods respectively may be explained. (4) Saturation phenomena in high-pressure ionisation chambers and electroscopes may be affected. Photographs of cloud tracks are presented in support of these suggestions. F. C. C.

1135. Three Types of Cosmic-Ray Fluctuations and Their Significance. R. A. Millikan, C. D. Anderson and H. V. Neher. *Phys. Rev.* 45. *pp.* 141–143, *Feb.* 1, 1934.—A theory of cosmic-ray bursts is advanced with which the energy released in them is assumed to come not from the cosmic-rays themselves but from the battery which charges the electroscope. These bursts then represent, according to this theory, instrumental accidents which must be eliminated before the remaining fluctuations can be interpreted. The discovery that the remainder of the ionisation observed in a cosmic-ray electroscope is due wholly to positrons and negatrons shooting through the chamber makes it possible to compute the fluctuations to be expected from a random distribution of these electron shots. The observed fluctuations, after the elminations of bursts, are found to be somewhat larger than the fluctuations thus computed. From the amount of this excess the percentage of cosmic-ray " showers " (two or more associated tracks) can be computed and is found by Evans and Neher to be in general agreement with the number directly observed in cloud-chamber experiments. [See following Abstract.] AUTHORS.

1136. Nature of Statistical Fluctuations with Applications to Cosmic Rays. R. D. Evans and H. V. Neher. *Phys. Rev.* 45. *pp.* 144–151, *Feb.* 1, 1934.—I. The square of the mean deviation D of the combined effect of several random processes releasing an average of $x, y, z \cdots$ particles per unit time and producing $a, b, c \cdots$ ion pairs, respectively, per particle, is $D^2 = a^2x + b^2y + c^2z + \cdots$, regardless of whether the separate effects are added or subtracted by the experimental arrangement. For tube-counters, point-counters, scintillation screens and particle counting chambers, $a = b = c = 1$; for ionisation chambers $a, b, c \cdots$ are unequal. II. From the standpoint of statistical fluctuations the use of two identical instruments in a differential circuit is inferior to the use of a single instrument. III. The natural observational limit for the measurement of x particles against a background of y particles is $x = 0\cdot67(y)^{\frac{1}{2}}$. IV. The statistical fluctuations in the ionisation produced by cosmic rays in a spherical ionisation chamber are treated rigorously and the fluctuations due to heterogeneity of range and to showers are derived. V. Application to existing data shows that the showers observed in cloud chamber photographs of the cosmic radiation are also present in the ionisation chamber in about the same frequency and multiplicity as indicated by the cloud chamber results. The tube-counter investigations of the cosmic-ray flux are also in agreement with the deductions from the statistical fluctuations in the ionisation chamber. An upper limit of 70 ± 10 ion pairs per cm. in air at 1 atmosphere is set for the total ionisation along the path of an individual cosmic-ray secondary. The size and the relative frequency of occurrence of showers is appreciably greater at 14,700 feet elevation than at sea level. These showers are quite distinct from the ionisation bursts or Stösse observed by Hoffmann, Steinke and others.. [See preceding Abstract.[AUTHORS.

See also Abstracts 1063, 1071, 1118, 1119, 1258.

RADIATION, GENERAL THEORY.

1137. Rapid Variations of Scalar Potential in Space. C. Manneback. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 201–215, *Dec.* 30, 1933.—The author refers to the conclusions advanced by del Pulgar [see Abstract 4074 [(1933)] regarding the classical electromagnetic equations. He establishes first the equations according to the Helmholtz-Ferrier theory and next those based on del Pulgar's objections to this theory. The difficulties raised by del Pulgar's theory are then discussed. The electrical field is next broken up into an irrotational and a rotating part. If this decomposition is to have a physical character it ought to apply to any part of the field. Consequently one should not attribute a physical character to a purely mathematical decomposition of the electrical field into two components, respectively rotational and irrotational, even if this decomposition can be made in a single manner. The mechanism of electromagnetic rays of a system of conductors is discussed, and it is considered that those produced by electrical oscillations are a global phenomenon and it is not possible to consider separately the rays of certain parts of the source. R. S. R.

1138. Representation of Radiation Reaction in Wave Mechanics. W. F. G. Swann. *Frank Inst., J.* 217. *pp.* 59–71, *Jan.,* 1934.—It is well known that the wave mechanical ψ equation leads to the conclusion that the centroid of the wave mechanical electron should move according to the classical electrodynamic equation of motion in which, however, the terms representing what is commonly called radiation reaction are absent. If $\mathbf{v}$ is the velocity of the electron, the classical rate of change of momentum is $md/dt\{\mathbf{v}/(1 - v^2/c^2)^{1/2}\}$. The equation of motion including radiation reaction terms may be regarded as obtainable by replacing this quantity by one obtained by operating upon it with the operator P^{-1}, $\mathrm{P} = \{1 - a_1 kd/dt + a_2 kd/dt(kd/dt) - \cdots\}^{-1}$, where a_1, a_2, etc., are constants and $k = (1 - v^2/c^2)^{-1/2}$. The main purpose of the paper is to show that if there be any relativistically invariant ψ equation which leads to the classical equation of motion without radiation reaction terms, then by replacing the vector and scalar potentials $\mathbf{U}$ and ϕ in that equation by $\mathrm{P}(\mathbf{U})$ and $\mathrm{P}(\phi)$, a relativistically invariant equation of motion will be obtained including the radiation reaction terms, provided that the d/dt in P be now regarded as $\partial/\partial t + (\mathbf{u}\cdot\mathrm{grad})$, where $\mathbf{u}$ is the velocity of the wave mechanical density distribution at a point. The purpose is to use the power to produce the equation of motion as a criterion for suggesting the proper modification of the ψ equation to apply in these cases where, on the classical theory, the electron would suffer great acceleration, as in ionisation by rapidly moving corpuscles. AUTHOR.

1139. Nature of the Photon. L. de Broglie. *Comptes Rendus,* 198. *pp.* 135–138, *Jan.* 8, 1934.—The luminous electromagnetic field is brought into the theory previously developed [see Abstract 626 (1934)].

The photon is conceived as a luminous corpuscle accompanied by an anti-corpuscle, analogous to the positive and negative electrons of Dirac's theory. J. S. G. T.

See also Abstracts 958, 1111, 1318, 1319, 1320, 1345.

REFLECTION. REFRACTION AND DISPERSION.

1140. Graphical Method to Determine the Fresnel Coefficients of Reflection and Refraction. A. Biot. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 195–201, *Dec.* 30, 1933.—The equations $1+x_1=y_1/n$, $1-x_2=y_2$, $1-x_1=y_1 \cos r/\cos i$, $1+x_2=(y_2/n)(\cos r/\cos i)$, may be used to calculate the coefficients of reflection (x_1 and x_2) and of refraction (y_1 and y_2). The paper describes graphical methods by which these quantities can be determined readily for different values of i and n. The precision of the methods and their application are discussed. W. D. W.

1141. Change of Phase by Normal Reflection from Very Thin Layers of Gold. P. Rouard. *Comptes Rendus,* 198. *pp.* 164–166, *Jan.* 8, 1934.—The change of phase has been measured for reflection from thin gold surfaces, both in air and in glass, and tables are given showing the results for different wave-lengths of light and different thicknesses of gold film. [See also Abstract 3524 (1933).] W. D. W.

1142. Reflection Spectrum of Quartz in the Region of 9μ. S. Silverman. *Phys. Rev.* 45. *pp.* 158–160, *Feb.* 1, 1934.—The reflection spectrum of quartz, cut perpendicularly to the optic axis, has been previously studied in the region of 9μ [see Abstract 1897 (1931)]. It was felt advisable to repeat this work by using polarised light and a crystal section cut parallel to the optic axis. With the same high resolution spectrometer and a new type of resonance radiometer which employs a Nichols type radiometer, sufficient sensitivity was obtained to bring out a maze of fine structure. It is to be noted that much of this fine structure is produced at identical frequencies for both the ordinary and the extraordinary rays. This might indicate that these frequencies are produced by a lattice rather than by an ionic motion, or that such agreement is entirely fortuitous because of the extreme complexity and closeness of the lines. AUTHOR.

1143. Precise Determination of Focal Lengths of Short-Focus Negative Lenses. D. Teodorescu. *Soc. Române Fiz., Bul.* 35. *pp.* 143–147, *Nov.–Dec.,* 1933. *In French.*—A method is described in which two convex lenses are placed in afocal adjustment and the negative lens to be tested is placed between them in a position that maintains this adjustment. The front positive lens is removed and the negative lens moved until the combination with the second positive lens again gives an afocal adjustment. The distance through which the negative lens has to be moved gives a direct and accurate value for its focal length. W. D. W.

1144. Image-Distortion and Other Effects Due to the Glass-Thicknesses in Lens Systems. H. D. Taylor. *Phys. Soc., Proc.* 46. *pp.* 283–291 ; *Disc.,* 291, *March* 1, 1934.—This paper discusses the optical influence upon distortion of image, or departures from correct pictorial representation, caused by the considerable thicknesses of glass involved in the construction of high-class photographic lenses or projectors of large angular field of view. Specific instances of such influence and the appropriate formulæ, for expressing the amount of such distortion, are given. AUTHOR.

1145. Refractive Index of Water. (Miss) O. Jasse. *Comptes Rendus,* 198. *pp.* 163–164, *Jan.* 8, 1934.—The refractive index of water has been measured by an interference method which determines the difference in optical path between two parallel faces when the intervening space is filled first by air and then by water. A table of values is given for the index, for four wave-lengths, of water distilled at various temperatures between 0 and 94° C. W. D. W.

1146. Refraction and Dispersion of Gases and Vapours. *Zeits. f. phys. Chem.* 24. *Abt.B.* 2–3. *pp.* 103–214, *Jan.*, 1934.

Part I. " General Introduction," by **K. Fajans.** The objects of the series of investigations described below were to determine: (1) by what alterations in optical properties the formation of compounds from free gaseous ions or from atoms is accompanied and the relation between such alterations and the linkage-type of the compound formed; (2) by what changes in optical properties the action of the van der Waals forces between neutral molecules is accompanied, and (3) to what extent the refraction of free molecules is dependent on the temperature. The evolution of the experimental arrangement used is briefly traced and the derivation of reliable values for the separate ionic refractions is discussed at length.

Part II. " Refraction and Dispersion of Air, Hydrogen Sulphide and Water Vapour in the Visible Region," by **J. Wüst** and **H. Reindel.** Measurements of the refraction and dispersion of air at the ordinary temperature, carried out to test the gas-interferometric apparatus used, gave results agreeing well with the best values previously obtained. Similarly C. and M. Cuthbertson's values for the refraction and dispersion of hydrogen sulphide at the ordinary temperature and for the dispersion of water vapour at 130–150° C. [see Abstract 1642 (1913)] are confirmed.

Part III. " Refraction and Dispersion of Mercury Halide Vapours in the Visible Region," by **M. A. Bredig, T. v. Hirsch** and **J. Wüst.** The refraction and dispersion of the vapours of $HgCl_2$, $HgBr_2$ and HgI_2 have been measured at 340° C. The molecular refractions of these compounds are not additively related to those of the free gaseous ions. The deviations from additivity do not obey the laws established by Fajans and Joos [see Abstract 2239 (1924)] for the hydrogen halides and alkali metal halides, the same being the case for the molecular dispersions. These results are related to the dissimilarity between Hg^2-ions and the noble gases. A measurement of the refraction of $HgBr_2$ vapour at 440° shows that the influence of temperature on the refraction is less than 0·003 per cent per degree.

Part IV. " Refraction and Dispersion of Aluminium Chloride and Bromide Vapours in the Visible Region," by **M. A. Bredig** and **F. K. V. Koch.** The measurements were made at 230° and 300° C. As with other compounds with kation of noble-gas type, the extent of the diminution in the refraction due to the formation of molecules from free gaseous ions increases with increasing deformability of the halogen, *i.e.* from chloride to bromide, and fits in with the values for the corresponding effect for other kations of the neon type.

Part V. " Refraction and Dispersion of Aluminium Iodide Vapour in the Visible Region," by **F. K. V. Koch** and **H. Kohner.** The decrease in the refraction on formation of the Al_2I_6 molecule from free gaseous ions is smaller than would be expected from the behaviour of the corresponding chloride and bromide and from the regularities observed with numerous halides. For this behaviour the relatively complicated structure of the double molecule is responsible.

Part VI. "Refraction and Dispersion of the Vapours of Certain Halides of Elements of the Fourth Periodic Group, in the Visible Region," by **P. Hölemann** and **H. Goldschmidt.** Various modifications were introduced into the apparatus to allow the interference bands to be focussed more rapidly and to give increased accuracy. The values given for the refraction of water vapour by Cuthbertson (*loc. cit.*) and for that of mercuric chloride vapour by Bredig, v. Hirsch and West (Part III, above) are confirmed. The values found for CCl_4 and $SiCl_4$ are lower by 0·6 per cent and 0·9 per cent respectively than those given by Lowery [see Abstract 385 (1932)]. The dispersion curve for $SiCl_4$ is parallel to that of Lowery, but the CCl_4 curve is steeper [see Abstract 54 (1928)]. As was found by Fajans and his collaborators for other groups of compounds, the diminution in refraction accompanying the formation of the compound shows increasingly negative values in the order $SnCl_4$, $SiCl_4$, CCl_4 (decrease of the radius of the central kation) and, at $\lambda=\infty$, in the order $SnCl_4$, $SnBr_4$, SnI_4 (increasing deformability of the anion).

Part VII. "Refraction and Dispersion of Stannous Halide Vapours in the Visible Region," by **H. Goldschmidt** and **P. Hölemann.** Measurements were made on $SnCl_2$, $SnBr_2$, and SnI_2 at about 700° C. For the chloride and bromide the dispersion is expressed by a simple formula but with the iodide, owing to strong absorption, considerable differences occur between the measured and calculated values. The change in refraction accompanying the formation of the vapour molecules from free gaseous ions does not show the systematic graduation found with numerous other groups of substances. In the passage from quadrivalent to bivalent tin, marked increase occurs in the equivalent refraction of the halide, this increasing with increasing magnitude of the anion. T. H. P.

1147. Refraction Measurements on Crystals. P. Wulff and D. Schaller. *Zeits. f. Krist.* 87. *pp.* 43–71, *Jan.*, 1934.—The densities of the following salts are determined: CsCl, NaBr, $NaBr.2H_2O$, $CaCl_2.4H_2O$, $CaCl_2.6H_2O$, $Na(CH_3COO).3H_2O$, Na_2SO_4, $CaSO_4$, $CaSO_4.2H_2O$, Ag_2SO_4 and $TlClO_4$. The refractive indices are also determined for the sodium D-line and in some cases for other lines of the visible spectrum. The molar refraction of salts isomorphous with the above, having inert-gas-like kations but similar molecular volumes is found, except in a few cases, to be such as to support the work of Fajans and Joos regarding the influence on the refractive index, of the electrostatic fields of neighbouring ions. The exceptions are the thallium halides, in which the binding is homopolar. J. T.

1148. Refraction, Dispersion and Absorption of Isomorphous Salts. P. Wulff and A. King. *Zeits. f. Krist.* 87. *pp.* 72–99, *Jan.*, 1934. —The densities of $Ba(NO_3)_2$ and $Pb(NO_3)_2$ are determined, also their refractive indices for four wave-lengths in the visible spectrum. The absorption edges in the ultra-violet are obtained for $Ba(NO_3)_2$, $Pb(NO_3)_2$, $PbSO_4$, $TlSO_4$ and $TlClO_4$. For $SrSO_4$ it is found that for wave-lengths down to 2000 Å the absorption is not appreciable. The relation between molar refraction and ionic forces is discussed in several cases. From reciprocal dispersion curves and absorption curves it is shown that $PbCl_2$ does not possess a typical ionic lattice. J. T.

1149. Polarisability and Molecular Refraction of Alkali Ions. R. Schoppe. *Zeits. f. phys. Chem.* 24. *Abt.B.* 2–3. *pp.* 259–262, *Jan.*, 1934.—The molecular refraction and polarisabilities of alkali ions have been recalculated according to the method of Herzfeld and Wolf. These values are compared with values calculated according to other theories by Fajans and Joos, and by Mayer. Comparison with experimental data is made and good agreement is found. W. R. A.

1150. Refractive Dispersion of Organic Compounds. Part IV. Cyclohexene and 1 : 3-Cyclohexadiene. C. B. Allsopp. *Roy. Soc., Proc.* 143. *pp.* 618–630, *Feb.* 1, 1934.—Refractive indices at 20° over a long range of visible and ultra-violet wave-lengths are recorded for cyclohexene and for 1 : 3-cyclohexadiene, and absorption curves for the two compounds in solution in cyclohexane are reproduced. The introduction of the second double bond in the diene is accompanied by the development of a new band system in the ultra-violet which is apparently characteristic of the conjugated system. The molecular refraction, M_D, of 1 : 3-cyclohexadiene is found to be normal, despite the conjugation, but in the neighbourhood of the absorption band the refractive indices increase very rapidly and exceed those of benzene at short wave-lengths. The refractive dispersion of each compound in the region of complete transparency can be represented by an equation containing two variable terms, the partial refractions of a high frequency in the Schumann region and of a low frequency in the ultra-violet respectively. That of the low frequency in the case of cyclohexadiene is much larger than the corresponding term for cyclohexene, and is responsible for the higher refractive indices exhibited by the conjugated compound. [For Parts I–III see Abstract 792 (1932).] C. B .A.

1151. Refractive Index of H^2H^2O. Refractive Index and Density of Solutions of H^2H^2O in H^1H^1O. D. B. Luten, Jr. *Phys. Rev.* 45. *pp.* 161–165, *Feb.* 1, 1934.—A determination has been made of the refractive index of nearly pure $H_2{}^2O$ and of a 50 % solution of $H_2{}^2O$ in $H_2{}^1O$ over a range of temperatures and wave-lengths. In both cases temperatures of maximum refractive index have been found. The differences between these temperatures and the temperature of maximum refractive index for ordinary water are in accord with the differences in those physical properties of the two kinds of water which have already been investigated. The dispersion of $H_2{}^2O$ is lower than that of $H_2{}^1O$. The densities and refractive indices of solutions of different concentrations of $H_2{}^2O$ in $H_2{}^1O$ have been determined. It is found that these solutions do not obey the laws of the ideal solution to the extent that the partial molal volumes are functions of the concentration of the isotopic water. This deviation from ideality is not found in the refractive indices of these solutions. AUTHOR.

1152. Precise Measurements of Dispersion in Nitrogen. C. E. Bennett. *Phys. Rev.* 45. *pp.* 200–207, *Feb.* 1, 1934.—A new and much improved displacement interferometer has been built after the general plan of the one previously described [see Abstract 2226 (1931)] to measure simultaneously refractive index and dispersion constants for a gas over a range of pressures above atmospheric. It is constructed as a single unit on a steel I-beam framework 10 feet long and 2 feet wide. The whole apparatus is supported on automobile inner tubes which very effectively eliminate vibration. The features also include a G.E. S-1 sunlamp light source, aluminium mirrors, a carefully calibrated micrometer screw of high quality and an improved temperature control. Observations made on nitrogen at four wave-lengths, 5780 Å, 5461 Å, 4359 Å and 4047 Å, corresponding to pressure runs up to 14 atmospheres measured by a Keyes dead-weight gauge, at temperatures of 50° C., 30° C. and 0° C. give readings that are linear with pressure to such a degree that the Cauchy dispersion constants can be expressed to four significant figures. The results for N.T.P. conditions are; $A_0 - 1 = 0\cdot0002932$ and $B_0 = 1\cdot637 \times 10^{-14}$. Since $A_0 - 1$ is the extrapolated infinite wave-length refractive index, a dielectric constant $\epsilon = 1\cdot0005864$ is this predicted. This agrees with published determinations. The refractive index at any wave-length can be computed from these results and values so calculated are found to agree with values found by other methods, which are not suitable for direct extrapolation to infinite wave-length and which are not likely to be so accurate. AUTHOR.

1153. Theory of the Microscope. Part II. Dark-Ground Illumination. L. C. Martin. *Phys. Soc., Proc.* 46. *pp.* 231–248; *Disc.*, 249–251, *March* 1, 1934.—This paper applies the methods developed in a previous paper [see Abstract 2247 (1931)] to the discussion of the effects in dark-ground illumination when the image of the source of light is projected into the object plane by an illuminator of the symmetrical type. The treatment is two-dimensional. The conditions necessary for the formation of genuine and spurious images are investigated, and it is shown that the Abbe principle is theoretically valid in the cases considered. A short practical investigation with Grayson's rulings supports the theoretical conclusions, but indicates the desirability of closer examination of the causes of misleading interference phenomena. AUTHOR.

1154. Construction and Use of a Pfund Parallel Plate Refractometer. M. A. Countryman and W. Kunerth. *J.O.S.A.* 24. *pp.* 25–28, *Jan.*, 1934.—The use of a parallel plate refractometer is described as applied to the determination of the rate of change of index of refraction of such liquids as varnishes and lacquers as they dry. Curves of 9 different liquids are given and discussed. The apparatus provides a rapid and simple method of determining the refractive index of liquids within an accuracy of 0·5 %. [See Abstract 2666 (1931).] W. D. W.

1155. Method of Observing Ripples on the Surface of Liquids. V. N. Thatte and P. S. Nilkanthan. *Journ. Sci. Instruments.* 11. *pp.* 29–30, *Jan.*, 1934.—A method is described in which a narrow discharge tube is held very near the surface of a liquid and viewed by reflection in the liquid. If the tube is modulated at the same frequency as the fork producing the ripples, a steady wavy line is seen, from which the wave-length can easily be measured. W. D. W.

See also Abstracts 918, 1109, 1165.

SPECTROSCOPY.

1156. Infra-Red Grating Spectra. F. Paschen and R. Ritschl. *Ann. d. Physik*, 18. 8. *pp.* 867–892, *Dec.*, 1933.—It is shown how the properties of the grating render it particularly suitable for the experimental part of the analysis of infra-red emission spectra. The Al II spectrum was investigated with it and found to agree broadly with the theory of Goudsmit and Bacher, especially for the partially or completely degenerate triplet terms. The construction of the special light-source used is described. The spectrum contains new infra-red lines of Al I, He I and II, Zn I and II. Measurements lead to extensions and refinements of the term systems involved and to the correction of previous values of some of the shorter wave-lengths. D. H. F.

1157. Method of Producing the Spectrum of Atomic Nitrogen. D. Séférian. *Comptes Rendus*, 198. *pp.* 68–69, *Jan.* 3, 1934.—Two rods of tungsten of 3 mm. dia. are placed parallel to each other at a distance of 2–3 mm. A current of nitrogen circulates round these electrodes. The gas is excited by an a.c. arc at 110 volts, 20–50 amperes, between the electrodes. Near the top of the electrodes 4 groups of rays are found which may be attributed with some certainty to neutral atomic nitrogen. [See following Abstract.] J. E.

1158. Spectrum of Atomic Nitrogen (N I) in Ammonia and in Mixtures of Hydrogen and Nitrogen. D. Séférian. *Comptes Rendus*, 198. *pp*. 358–360, *Jan*. 22, 1934.—It has been previously noted [see preceding Abstract] that excitation of nitrogen in a tungsten arc gives (*a*) 3 groups of lines due to extra atomic nitrogen; (*b*) a combination spectrum in addition to the incandescent spectrum. This work shows by a similar means of excitation: (1) that in ammonia, the first four Balmer lines appear together with the continuous atomic spectrum of hydrogen; in addition there are 3 groups due to neutral atomic hydrogen; (2) in a mixture of hydrogen and nitrogen exactly similar results are obtained; (3) the continuous spectrum is due to metallic atoms in the neighbourhood of the electrodes. J. E.

1159. Excitation to Light Emission of Hydrogen Canal Rays. R. Döpel. *Zeits. f. Physik*, 87. 5–6. *pp*. 356–360, *Jan*. 15, 1934.—The author seeks to decide whether emission of the Balmer lines by hydrogen canal rays takes place by the capture of an electron by a proton and subsequent quantum jumps from level to level or by direct excitation of neutral hydrogen canal rays by collisions with stationary neutral particles in which the hydrogen electron is transferred to the initial orbit of the emission line. By photographing with a slitless spectroscope a fine pencil of canal rays emerging into hydrogen or helium through a gap across which an electric field was applied to deflect all protons, it was shown that the Balmer line emission from the pencil was unaffected. Thus hydrogen canal rays must be excited to light emission by collisions between neutral atoms. It is shown that not more than 5 % of the emission can arise by neutralisation of protons, and that not more than one neutralisation in 1000 leads to a Balmer emission. A further deduction is that the most probable mode of recombination of proton and electron is by a radiationless transition in a collision of the second kind. W. S. S.

1160. Multi-Coloured Hydrogen (Bunter Wasserstoff). W. Gerlach. *Zeits. f. Physik*, 87. 5–6. *p*. 409, *Jan*. 15, 1934.—The author objects to the use of the expression "*bunter Wasserstoff*" by Güntherschulze and Betz [see Abstract 3552 (1933)]; the effects observed are those associated with hydrogen contaminated with mercury vapour. J. S. G. T.

1161. Mean Lives of Excited Neon Atoms. J. H. E. Griffiths. *Roy. Soc., Proc*. 143. *pp*. 588–604, *Feb*. 1, 1934.—A method of measuring the average lives of the excited states of neon is described, in which a Kerr cell is used to find the lag between the emission of light and the current in a h.f. discharge in neon. It is shown theoretically how this lag should depend on the average life of the state. The results obtained agree with the theory if allowance is made for a small lag between the excitation and the current in the discharge tube. An explanation of this extra lag is given in terms of the motion of the electrons in the discharge. Experiments with a narrower tube confirm this view, the extra lag becoming negligible. The values of τ measured ranged from $3{\cdot}9\times10^{-8}$ sec. for the line λ 5853 to 20×10^{-8} sec. for λ 6402, and it is shown that lines originating from the same upper level give the same value of τ. The advantages of the method are: It may be used for any atom whose spectra can be produced in a h.f.

discharge. Sufficient light is produced to enable a spectrograph to be used. The quantity measured, *i.e.*, the lag, gives to a first approximation, the average life itself. Theoretical considerations can then be used to correct this value. The form of the excitation curve while having a small influence on the result does not produce a first order effect. AUTHOR.

1162. Infra-Red Absorption Spectra of Monohalogen Derivatives of Saturated Aliphatic Carbon Compounds. J. Lecomte. *Comptes Rendus*, 198. *pp.* 65–67. *Jan.* 3, 1934.—With the infra-red recording spectrometer already described [see Abstract 3007 (1933)] the author has taken the absorption spectra of 20 substances in the liquid state, having 2 to 7 atoms of carbon. On the average a dozen bands are obtained with each. Straight chain homologues bearing the same halogen have spectra which apart from certain analogies are markedly different as are the spectra of isomers such as the chlorides of normal, iso and tertiary butane. Where the Raman frequencies are available there is good agreement with the absorption maxima. Comparison of the bands in propyl chloride, bromide and iodide shows a progressive though irregular shift of frequencies to lower values with increasing atomic weight of halogen. For *straight* chain compounds 2 fundamental vibrations are found: 650 and 725 cm^{-1}. with Cl, 560 and 645 cm^{-1}. with Br, 505 and 590 cm^{-1}. with I—independent of the number of C atoms. There is another vibration, X—H, indicated which does depend on chain length. For *branched* chain compounds the fundamental frequencies characteristic of the presence of halogens do depend slightly on the number of C atoms. J. E.

1163. Absorption Spectra from the Excitation of Inner Electrons. Part IV. Spectrum of Zinc between 1150 and 700 Å from the Excitation of the $(3d)^{10}$ shell (Zn I^b). Comparison of the Terms and their Values in Hg^{Ib}, Cd I^b and Zn I^b. H. Beutler and K. Guggenheimer. *Zeits. f. Physik*, 87. 3–4. *pp.* 176–187, *Dec.* 23, 1933.—Using discharges in helium, argon and hydrogen as sources of illumination those absorption lines of zinc vapour have been photographed which lie beyond the short wave end of the arc spectrum. The upper terms of these lines are arranged in a Rydberg series having $(3d)^9(4s)^2$, $^2D_{5/2}$ and $^2D_{3/2}$ of Zn^+ as limiting terms. These lines correspond with transitions from the Zn ground term $(3d)^{10}(4s)^2\ ^1S_0$ to $(3d)^9\ (4s)^2\ m\ p\ ^1P_1^0$, $^3P_1^0$ and $^3D_1^0$ or also for some diffuse lines to $(3d)^9\ (4s)^2\ m\ f\ ^1P_1^0$, $^3P_1^0$. The spectrum is designated Zn I^b. The terms agree well with those of Ga I. The lowest terms of the series $m\ p\ ^1P_1^0$, $^3P_1^0$ are diffuse; but those higher in the series are sharper. Close to each $m\ ^3P_1^0$ term there lies a shaper $m\ p\ ^3D_1^0$ term—both series converging to $^2D_{3/2}$ of Zn^+, the series $m\ p\ ^1P_1^0$ to the lower level $^2D_{5/2}$ as limit. A comparison of the Hg I^b, Cd I^b, and Zn I^b spectra is made. [See Abstract 642 (1934) and following Abstract.] W. R. A.

1164. Absorption Spectra from the Excitation of Inner Electrons. Part V. Doublet of Potassium Vapour at 660 Å from the Excitation of the $(3p)^6$ Shell. (KI^b Resonance Lines). H. Beutler and K. Guggenheimer. *Zeits f. Physik*, 87. 3–4. *pp.* 188–191, *Dec.* 23, 1933.—The two absorption lines of potassium vapour observed near 600Å with the helium continium as background are due to transitions $^2S_{1/2}\ (3\ p)^6\ 4\ s \rightarrow\ ^2P_{1/2,\ 3/2}\ (3\ p)^5(4s)^2$ and belong to the KI^b spectrum. [See preceding Abstract.] W. R. A.

1165. Line Absorption of Chromium Oxide and Absorption Spectra of Chromium Glasses. G. Joos and K. Schnetzler. *Zeits. f. phys. Chem.* 24. *Abt.B.* 5–6. *pp.* 389–392, *Feb.*, 1934.—At −190° pure

Cr_2O_3 exhibits five diffuse absorption lines which are characteristic of the Cr_2O_3 lattice. Cr_2O_3 does not dissolve in B_2O_3, the lines persisting in the spectrum of a molten mixture of the two substances. They disappear, however, on the addition of alkali, when, despite the low temperature, the character of the spectrum is that of an aqueous solution. C. B. A.

1166. Fine Structure in the As II Spectrum. S. Tolansky. *Zeits. f. Physik*, 87. 3–4. *pp.* 210–216, *Dec.* 23, 1933.—A repetition of previous work in which certain results of Rao [see Abstract 4507 (1933)] are criticised. Rao had reported that four lines in Tolansky's earlier work had fine structure, but repetition confirms the previous result that they are single. Examination of plates obtained in the earlier work gives further confirmation. Using Rao's expansion of the coarse structure analysis the interval factors for three new terms are reported. The nuclear spin of 3/2 for arsenic is further substantiated. [See Abstract 5014 (1932).] W. R. A.

1167. Spectrum of Fluorine, F II, F III, F IV. I. S. Bowen. *Phys. Rev.* 45. *pp.* 82–86, *Jan.* 15, 1934.—The spectrum of fluorine extending from 125 Å to 620 Å has been obtained by using a 2 m. grazing-incidence spectrograph. A large number of these lines, including nearly all of the stronger ones, have been classified as transitions in the F II, F III and F IV ions. This has made possible the classification of additional lines measured by Dingle in the longer wave-length regions. These analyses yield the following ionisation potentials: F II 34·81 volts, F III 62·35 volts, F IV 87·34 volts. AUTHOR.

1168. Spark Spectra of Bismuth, Bi III and Bi II. M. F. Crawford and A. B. McLay. *Roy. Soc., Proc.* 143. *pp.* 540–557, *Feb.* 1, 1934.—The results are given of an extended investigation of the term structures of the spectra of Bi II and Bi III. The values of these spectral terms are recorded and tables of classified wave-lengths between 10,000 Å and 175 Å that were used in evaluating them are given in the paper. The paper includes considerable information on the fine structure of the spectral lines analysed. AUTHORS.

1169. Spectra of Br V, Br VI and Br VII. A. S. and K. R. Rao. *Phys. Soc., Proc.* 46. *pp.* 163–168, *March* 1, 1934.—The vacuum spark spectra of bromine have been investigated under different degrees of excitation in the region λ 1400 to λ 400, by means of a Siegbahn spectrograph. From a careful scrutiny of the plates the lines have been assigned to the different stages of ionisation of the element. With the aid of these the principal members of the spectra of Br V, VI and VII, involving the low-lying terms, have been identified. AUTHORS.

1170. Determination of the Relative Intensities of the Components of the Multiplet $a^3F - y^3F^0$ of FeI. J. Piérand. *K. Akad., Amsterdam, Proc.* 37. 1. *pp.* 16–19, 1934.—The multiplet $a^3F - y^3F^0$ of Fe I is one of a number of multiplets whose components exhibit different relative intensities in different stars. The relative intensities of the components of this multiplet are measured in the emission from an arc between silver electrodes containing about 1 % of iron; the weaker components do not appear to possess the theoretical intensities given by the simple Sommerfeld sum-rule. This effect may lie within the limits of experimental error as may also a small variation of relative intensity which was observed on variation of the current in the arc. J. E. K.

1171. Pressure Effects on Spectrum Lines. M. Kulp. *Zeits. f. Physik*, 87. 3–4. *pp*. 245–254, *Dec*. 23, 1933.—Among the observed effects of pressure, as studied by potential curves, are asymmetry, shift and widening. Certain principal types are chosen from among the manifold possibilities, the changes due to increase of pressure and interchange between higher members of series are discussed, and application of experimental measurements are made to explain the various influences of the rare gases on caesium. F. S.

1172. Isotope Displacement and Hyperfine Structure in the Arc Spectra of Chromium, Molybdenum and Tungsten. N. S. Grace and K. R. More. *Phys. Rev*. 45. *pp*. 166–169, *Feb*. 1, 1934.—Several of the stronger lines of Mo I and W I in the region 4000 to 6100 Å are found to possess structure. The W I lines are separated into three components which are roughly equally spaced with an overall separation of 0·1 cm.$^{-1}$ This structure is attributed to an isotope displacement of the even isotopes. Some of the Mo I lines are resolved into two components, while others, though not resolved, are broad and nonsymmetrical. The two component lines, with separation of 0·05 cm.$^{-1}$, are interpreted as being due to spin splitting of the odd isotopes. The broad lines with a width of about 0·06 cm.$^{-1}$ are interpreted as being due to a small isotope displacement. There is some evidence that $I = 1/2$ for the odd isotopes of both Mo and W. There is also evidence that the magnetic moments of these odd isotopes are not large. The isotope displacements in the spectra of several elements are compared and the direction of displacement is discussed. AUTHORS.

1173. Rôle of the Spin in Multipole Radiation. H. C. Brinkman. *Physica*, 1. 2. *pp*. 97–103, *Dec*., 1933. *In German*.—To the approximation of the electric dipole radiation, it follows both from Schrödinger's and Dirac's theory of the electron, that only the orbital motion of the electron contributes. It is here shown that for the higher approximations of the magnetic dipole radiation and multiple radiations, the time variation of the magnetic moment due to spin has also to be allowed for. The analysis is based on the Dirac equations for the electron. W. S. S.

1174. Changes produced by a Dissolved Substance on the Infra-Red Absorption Spectrum of a Solvent. Part II. Influence of the State of Association of Water Due to H and OH. R. Suhrmann and F. Breyer. *Zeits. f. phys. Chem*. 23. *Abt. B*. 3–4. *pp*. 193–212, *Nov*., 1933.—With solutions of HCl and H_2SO_4 the water bands at 0·98, 1·20 and 1·45 μ were suppressed, and that at 1·45 was only slightly affected. From the band of 1·45 μ in HCl solutions the number of water molecules affected was calculated as 1 per H ion. From the results values for the hydroxonium concentrations were calculated and the hydroxonium absorption curves show continuous absorption on the long-wave side of the water bands. There is probably no definite chemical compound formed between H ions and water molecules. Water absorption curves in KOH solutions are similar to those in acid solutions, the calculation in this case gives about 2 water molecules per OH ion. There is continuous absorption on both sides of the water bands and a similar type of binding as with H ions is postulated. [For Part 1 see Abstract 1883 (1933).] W. R. A.

1175. Infra-Red Absorption of Organic Substances. Part III. A. Roth. *Zeits. f. Physik*, 87. 3–4. *pp*. 192–205, *Dec*. 23, 1933.—An investigation of the absorption between 0·8 and 2·6 μ has been made on propyl chloride, propyl bromide, isopropyl chloride, formic acid, methyl and ethyl formate, benzotrichloride, benzoyl chloride, methyl benzoate, anisole and anisaldehyde. Where possible the experimental data are compared with previous results. The spectra are discussed and the origin of the various bands considered. [For Part II see Abstract 3573 (1933).] W. R. A.

1176. Infra-Red Absorption Spectra of Nitrogen Dioxide and Tetroxide. L. Harris and G. W. King. *J. Chem. Phys.* 2. *pp.* 51–57, *Feb.*, 1934.—The absorption spectra form 1 to 4 μ of pure $NO_2 - N_2O_4$ mixtures in a long tube were examined with a rock-salt and a quartz spectrometer. Several new bands were discovered from 1·9 to 4 μ in the spectra of both NO_2 and N_2O_4. The NO_2 bands were analysed as combinations of two fundamentals. The N_2O_4 bands were interpreted as combinations and harmonics of reported fundamentals. Three bands of N_2O_4 lie at shorter wave-lengths than correspond to the work of dissociation into 2 NO_2. A study of the symmetry properties shows that only those models where the NO_2 groups are joined by the nitrgoen atoms would give rise to the observed infra-red spectrum. Some features of the spectrum seem to be in favour of the existence of molecules where the NO_2 groups do not lie in the same plane. AUTHORS.

1177. Ultra-Violet Absorption Spectra of Aromatic Substances. A. Hillmer and P. Schorning. *Zeits. f. phys. Chem.* 167. *Abt. A.* 5–6. *pp.* 407–420, *Jan.*, 1934.—The changes in the ultra-violet absorption spectra which occur when a phenolic hydroxyl, or two such groups in the ortho-position, is introduced, either free or etherified with methyl alcohol or with methylene glycol, into benzene, *n*-propyl benzene, allyl benzene, are studied with a view to detecting regularities in behaviour. Absorption curves are reproduced for the following substances : allyl benzene, esdragol, propenyl benzene, anol, anethol, guaiacol, eugenol, *iso*eugenol, safrol, *iso*safrol, dihydroeugenol, dihydrosafrol, and the methylene ether and allyl derivatives of *o*-dihydroxybenzene. C. B. A.

1178. Light Absorption and Double Bonds. K. W. Hausser. *Zeits. f. techn. Physik,* 15. 1. *pp.* 10–20, 1934.—An abstract of a lecture reviewing a large amount of unpublished work. Absorption spectra are recorded for three series of organic compounds containing increasing numbers of conjugated double bonds. Increase in this number moves the absorption regularly towards longer wave-lengths. The effect is examined quantitatively, and the results enable the absorptions of fifty other unsaturated compounds to be predicted accurately. In each series, the intensity of the absorption is approximately proportional to the number of conjugated double bonds. The structure revealed in the absorption spectra on examination at the temperature of liquid nitrogen shows that they are all of the same type, and is clearer the greater the number of double bonds present and the lower the temperature. The separation between the individual bands thus revealed corresponds with the frequency of an isolated double bond, 1600 cm.$^{-1}$ The Raman spectra of the multiply conjugated compounds contain the $C = C$ frequency very strongly, and this is excited the more easily the higher the number of conjugated bonds. As this number increases, however, the frequency diminishes. Similar regularities are observed in the fluorescence spectra of the diphenylpolyenes and of a large number of unsaturated compounds, provided that these are not ionic in structure. The ring system is not essential to fluorescence, which is also observed in unsaturated aliphatic acids and the carotinoids. C. B. A.

1179. Thermo-Optical Dissociation of Sulphur Dioxide. K. Wieland. *Faraday Soc., Trans.* 30. *pp.* 260–265, *Feb.,* 1934.—Comparison of the absorption spectra, in the Schumann region, of SO_2 at room-temperature and at 450°C. shows that at the higher temperature the bands due to SO_2 have almost completely vanished and a new spectrum is found. This consists of S_2 bands. On cooling the SO_2 spectrum reappears. Dissociation into S_2 and O_2 is improbable owing to the large energy of activation required and it is considered that the change is to S_2 and SO_3. A. S. C. L.

1180. Band Spectrum of Magnesium Hydride. A. Guntsch. *Zeits. f. Physik,* 87. 5–6. *pp.* 312–322, *Jan.* 15, 1934.—A newly found intercombination band of neutral magnesium hydride is described, which allows the more accurate calculation of the rotational constants of the higher $^2\Pi$ state. Twelve bands of ionised magnesium hydride are analysed, and term values, rotational constants, and dissociation values are given. Finally, the dependence of the spin coupling factor on rotation is discussed. A. C. M.

1181. Structure of the Band Spectrum of Mercury Vapour. S. Mrozowski. *Zeits. f. Physik,* 87. 5–6. *pp.* 340–355, *Jan.* 15, 1934.—An explanation of the peculiar character of the Steubing fluorescence band series is sought by taking account of the rotational energy in Franck's scheme of potential curves for the mercury molecule. W. S. S.

1182. Large Electronic Isotope Effects in Molecular Spectra. H. L. Johnston. *Phys. Rev.* 45. *pp.* 79–81, *Jan.* 15, 1934.—The large electronic isotope effect in the spin coupling of $^2\Pi$-terms, reported by Johnston and Dawson for boron monoxide and for the heads of the OH^2 bands is confirmed by measurements of the fine line structure in the isotopic OH bands. Both for BO and for OH the observed increase in the doublet spacings, in the molecule with the heavier isotope, agrees closely with the results to be expected from Hill and van Vleck's theoretical treatment of spin coupling energy, although their equations do not so well reproduce the separate doublets. This isotope effect is zero at the band origins, increases to a maximum (which amounts to 20 cm^{-1} in the 0″ vibrational level of OH) and approaches zero asymptotically at high rotational quantum numbers. A large electronic isotope effect in Λ-doubling is also observed for OH. This effect, which is zero at the band origin and increases with increasing rotation, amounts to 17 cm^{-1} at $K = 25$. It is not correctly accounted for by van Vleck's equations for Λ-doubling although *ratios* of the Λ-doublets in OH^1 and OH^2 are correctly given, for a case *b* molecule. No noticeable effect was observed on the spacings of the $^2\Sigma$-doublets in the excited state of OH. AUTHOR.

1183. Measurement of Arc Temperature from C_2 Bands. Transition Probability of Vibrational Transitions. D. T. J. ter Horst and C. Krygsman. *Physica,* 1–2. *pp.* 114–118, *Dec.,* 1933. *In English.*—By measuring the intensity distribution in the rotational bands of C_2 in the light emitted from a d.c. carbon arc in air at normal pressure, an estimate of the temperature of the arc was obtained. Assuming a Boltzmann distribution of molecules in the rotational levels, a plot of $\log_e(I/j)$ against Ej (I = intensity of the line of initial rotational quantum number j (P branch) or j + 1 (R branch) and Ej = rotational energy in the initial state) should give a straight line of slope $-(1/kT)$. Experimentally the data approximated to a straight line leading to T = 6000° K. in good agreement with the value T = 6500° K. deduced in a similar way from the CN band spectrum. Assuming the same temperature for the

vibrational bands and again a Boltzmann distribution in the vibrational levels of the C_2 molecule, the ratio of the transition probabilities for vibrational transitions 0 — 0 and 1 — 1 was determined. The value obtained (100/50) is in good agreement with a theoretical deviation due to Wurm.
W. S. S.

1184. Rotation Vibration Coupling in Diatomic Molecules. C. L. Pekeris. *Phys. Rev.* 45. *pp.* 98–103, *Jan.* 15, 1934.—A solution of the wave equation for the nuclear motion of a diatomic molecule with a Morse potential function and the rotational term included is given. The wave functions are found to have the same form as the functions obtained when the rotational term is neglected. The constants D_e and α_e in the equations $B_v = B_e - \alpha_e(v + \frac{1}{2})$ and $D_v = D_e + \beta_e(v + \frac{1}{2})$, are found to be given by the relations $D_e = -4B_e^3/\omega_e^2$ and $\alpha_e = 2x_eB_e(3[B_e/x_e\omega_e]^{\frac{1}{2}} - 3B_e/x_e\omega_e)$, a result which can also be derived from Dunham's formulæ. The last equation differs from the corresponding relation in Kratzer's formula by the term in parenthesis. This term is fairly constant for a number of molecules and has an average value of 0·7 ± 0·1 as was found empirically by Birge. The values of α_e show satisfactory agreement with experimental values for many molecules.
AUTHOR.

1185. Fluorescence Spectra of Antimony Vapour Excited by Cadmium, Zinc and Magnesium Sparks. R. Siksna. *Acta Physica Polonica*, 2. 3. *pp.* 253–265, 1933. *In German.*—This paper gives a more detailed account of experiments and results already reported in two previous publications [see Abstracts 4114 and 4116 (1933)]. The spectrograms obtained and the microphotometer records are reproduced.
L. A. W.

1186. Raman Spectrum of Water. J. Cabannes and J. de Riols. *Comptes Rendus*, 198. *pp.* 30–32, *Jan.* 3, 1934.—The Raman spectrum of water is found to consist of a broad band (A) at about 3450 cm^{-1}, a narrow band (B) at about 1650 and a very feeble band (C) at 350 to 750. Of these A (about 600 cm^{-1} broad) has a central maximum at 3436 and two weaker maxima at 3224 and 3625, all definitely polarised. Solution of $NaNO_3$ causes shifts to higher frequencies and the disappearance of the component 3625. In ice two sharper bands are found at 3158 and 3376; in gypsum (water of crystallisation) at 3411 and 3495. The band B is also polarised ($\rho = 0{\cdot}4$ approx.); it does not occur in ice or in gypsum. The very feeble band C shows two maxima at about 550 and 700 and is found to be polarised. The results are discussed in relation to the molecular structure of water, reference being made to the Raman spectrum of the vapour. The component 3625 of the broad band A is considered to be due to the H_2O molecule, and the components 3224 and 3436 are attributed to polymers.
L. A. W.

1187. Multiplicity of Certain Raman Frequencies of the Radical NO_3 in Nitrates of Valency Greater than One. Z. Ollano and G. Frongia. *N. Cimento*, 10. *pp.* 306–315, *July*, 1933.—An experimental study was made of the Raman frequencies 1440, 1030, 980, 720 cm^{-1} associated with the radical (NO_3), by measurements of the Raman lines given by monovalent (K, Na, NH_4, Hg), divalent (Mg, Mn, Ba) and trivalent (Al, Ce, La, Bi) nitrates in aqueous solution, using as exciting radiation the mercury lines at 4358·3 and 4046·8 Å. The Raman frequencies 1030 and 980 $cm.^{-1}$ were found to be simple for all the nitrates, but the frequencies 1440 and 720 $cm.^{-1}$ appeared simple for monovalent nitrates

and as doublets for divalent and trivalent nitrates. The doublet separation for 720 could be measured and was found to be about 40 cm.$^{-1}$. Assuming complete dissociation in solution, the four simple frequencies for monovalent nitrates are attributed to the ion $(NO_3)^-$. For divalent nitrates, the presence of ions $[(NO_3)M]^+$ in addition to $(NO_3)^-$ is postulated, with the result that the frequencies 1440 and 720 cm.$^{-1}$ are doubled. By considering the position of the metallic atom in the ion $[(NO_3)M]^+$ it is shown why only two of the frequencies are modified. Trivalent nitrates are assumed to dissociate into $(NO_3)^-$, $[(NO_3)_2M]^+$ and $[(NO_3)M]^{++}$, but by considering the structure it is shown why doublets are still obtained and not triplets.
W. S. S.

1188. Raman Band of OH in Nitric Acid. L. Médard and Thérese Petitpas. *Comptes Rendus*, 198. *pp.* 88–89, *Jan.* 3, 1934.—The band, attributed to OH, previously observed between 3100 and 3300 cm.$^{-1}$ in the Raman spectrum of solutions of NH_4NO_3 in HNO_3, is now observed in the spectrum of very pure HNO_3 alone, and it has a dissymetric structure. The band is also observed with solutions of KNO_3 in HNO_3. The spectrum of these solutions is similar in all respects to that of the NH_4NO_3 solutions. [See Abstract 676 (1934).] C. B. A.

1189. Raman Effect of Double Bonds between C and N in Organic Molecules. G. B. Bonino and R. Manzoni-Ansidei. *Accad. d'Italia, Mem.* 4. 20. *pp.* 759–776, 1933.—The constitution of the triple linking between carbon and nitrogen in the thiocyanates and isothiocyanates [see Abstract 3286 (1932)] is discussed. Further information is expected from projected measurements on the coefficient of depolarisation and the Raman line corresponding with this linking. Results are given of the examination of the Raman spectra of the oximes of a number of aliphatic and aromatic ketones and aldehydes, which have been shown by previous work to contain a true homeopolar double linking between carbon and nitrogen; the aromatic oximes investigated were all of the α-form. With all these oximes (except the sodium salts of the aromatic oximes) the line 1600–1700 cm.$^{-1}$ characteristic of a double linking is found. The hypothesis that the internal oscillation of C : N has a frequency comparable with that of C : C and is affected to the same extent by the neighbouring aromatic nucleus is confirmed. With the sodium salts of the aromatic oximes, the line of the aromatic nucleus remains at 1590 cm.$^{-1}$, but that of the linking C : N is displaced from 1620–1630 cm.$^{-1}$ to about 1540–1550 cm.$^{-1}$ This is analogous to Dadieu, Jele and Kohlrausch's observation [see Abstract 870 (1932)] that the N : O group of organic nitrites shows a line 1640 cm.$^{-1}$ whilst the nitro group shows a line 1560 cm.$^{-1}$ and is due, it is suggested, to a perturbation caused by the establishment of a semipolar bond at the nitrogen atom. T. H. P.

1190. Raman Spectra of Naphthalene Derivatives. S. Ziemecki. *Acad. Polonaise Sci. et Lettres, Bull.* 4–8 *A. pp.* 158–168, *April–Oct.*, 1933. *In German.*—The Raman spectra of α- and β-methyl-naphthalene, α- and β-chlor-naphthalene and α-bromo-naphthalene are investigated, using the experimental arrangement previously described [see Abstract 494 (1931)]. Repeated distillation at low pressure is found to lessen the continuous background of the spectra, but the results for the β-derivatives are incomplete. It is found that all the strong Raman lines of the β-derivatives are present in the spectra of the corresponding α-derivatives. The strongest frequency is 1376 cm.$^{-1}$ and is common to all the substances investigated: it is therefore considered to be characteristic of the naphthalene nucleus. A number of other frequencies also probably belong to the same class, though they exhibit certain fluctuations as we pass from one derivative to another. L. A. W.

1191. Raman Spectra of Aliphatic Ketones and Aldehydes. K. W. F. Kohlrausch and F. Köppl. *Zeits. f. phys. Chem.* 24. *Abt.B.* 5–6. *pp.* 370–388, *Feb.*, 1934.—Raman spectra are given for 16 aliphatic aldehydes R CHO (R = H up to C_9H_{19}), 13 methyl ketones CH_3 COR (R = CH_3 to C_9H_{19}) and 4 symmetrical ketones. With the aldehydes the line of frequency 1390 cm.$^{-1}$ is attributed to the group CHO and with the methyl ketones the line 590 cm.$^{-1}$ to the group CO CH_3. Various higher acids and their esters and also symmetrical ketones frequently show, however, faint lines at about 600 cm.$^{-1}$, and the origin of the line 590 cm.$^{-1}$ remains somewhat uncertain. The extended experimental data now available show that, in molecules containing primary side-chains, the CO-frequency (about 1700 cm.$^{-1}$) is independent of the length of the chain. The vibrations of a branched side-chain not in the α-position are also discussed. T. H. P.

1192. Raman Effect in the Study of Chemical Reactions. S. Parthasarathy. *Phil. Mag.* 17. *pp.* 471–476, *Feb.*, 1934. *Supplement.*—Raman spectra are observed for (i) a simple mixture of ethyl alcohol and acetic acid and (ii) the mixture after esterification by heating on a water-bath under a reflux condenser for ten hours. These are compared with the spectra of the pure alcohol, the pure acid and the pure ester. It is remarked that the extent of esterification could be determined by intesity measurements upon characteristic lines. Similarly the spectra of mixtures of acetic anhydride and ethyl alcohol are compared with those of the pure liquids, and evidence of reaction is obtained from the appearance of lines characteristic of ethyl acetate and acetic acid in the spectra of the mixtures. Analogous results are obtained for a mixture of acetic anhydride and water. In addition, the observed Raman frequencies of chloral, chloral hydrate (solid), monochloracetic acid (solid) and trichloracetic acid (solid) are recorded. L. A. W.

1193. Quantitative Spectral Analysis of Metals. A. Pfeiffer and G. Limmer. *A.T.M.* 3. *T6–7, Jan.* 31, 1934.—An account of the methods now available for the quantitative spectroscopic analysis of metals, covering the absolute method of "ultimate lines," comparison with standard alloys and solutions, the method of homologous pairs, and photometric (sector and polarisation) methods. C. B. A.

1194. Spectroscopy and Thermodynamics. C. Clusius. *Zeits. f. Elektrochem.* 40. *pp.* 98–101, *Feb.*, 1934.—This paper consists of two criticisms of a general review recently published by Zeise [see Abstract 222 (1934)]. In the first place objection is raised to the report of the author's calculations of the normal entropy of nitrous oxide. A new calculation from thermal data gives $S_{298 \cdot 1} = 51 \cdot 49$, a value which is 1·09 entropy units less than the corresponding value obtained from spectroscopic data. The difference is explained as due to a zero-point entropy of nitrous oxide. The second criticism concerns the conclusion of Zeise that the Nernst heat theorem is of general validity and must be regarded as the third law of thermodynamics. It is pointed out, with evidence, that this view is by no means generally held. L. A. W.

See also Abstracts 876, 1005, 1108, 1142, 1150, 1231, 1237, 1267, 1322.

VISION.

1195. Eye Model. U. P. Lely. *Physica*, 13*e*. 10. *pp*. 305–319, 1933. —A model of the human eye has a lens consisting of an immense drop, 7 cm. dia., of some liquid floating in water. The power of the lens may be varied continuously by supplying liquid to the drop. Different curvatures may be given to both sides of the lens by choosing different pressures of the water in which the drop floats. The images of Purkinje and their movements are demonstrated; the curve along which the image of the lens front moves is calculated, and it is demonstrated that the relative movement of these immages depends on the point of view of the observer. The model is 10 times as large, linearly, as the natural eye. A. D.

X-RAYS.

1196. Automatic Current Regulator for Gas X-Ray Tubes. H. Kersten. *Rev. Sci. Instruments*, 5. *pp*. 5–6. *Jan*., 1934.—Describes a photoelectric device for operating the needle valve of a continuously evacuated X-ray tube in such a way as to maintain a constant current. The pointer of the milliammeter is provided with a mirror reflecting a beam of light either on to one or two Weston photronic cells or between the two. When the milliammeter is recording a preset current, the light falls between the cells, but should the current rise the light falls on one cell, thereby operating a relay which in turn brings into action a servo motor which closes the needle valve. Should the current fall the light falls on the other cell, and the motor is caused to open the needle valve. G. E. B.

1197. Scattering of X-Rays by Silver. A. A. Rusterholz. *Helv. Phys. Acta*, 6. 8. *pp*. 565–569, 1933. *In German*.—Absolute measurements of the F-factors of the surface of silver 220 for Cu-Kα rays. The value obtained for the scattering is in full accord with theory. The K-electrons of the silver atoms do not take part in the scattering; the scattering is smaller than was to be expected according to Thomas-Fermi for the atomic number 47. Not all of the Pauli-Transitions of K-electrons to higher levels are found to be possible. A. D.

1198. Scattering of Homogeneous X-Rays of 0·25 to 0·40 Å. I. Backhurst. *Phil. Mag*. 17. *pp*. 321–351, *Feb*., 1934. *Supplement*.—Measurements were made of the variation in the total intensity of X-rays scattered from a homogeneous incident beam (obtained by crystal diffraction) for scattering angles ranging from 30° to 150°. Using powdered beryllium as scatterer, the angular variation of scattered intensity obtained agreed closely with wave-mechanics calculations for atomic scattering. Other measurements using water and organic compounds as scatterer gave the same angular variation as beryllium for angles greater than 60°. The relative proportion of modified and unmodified radiation scattered at 150° was determined by absorption measurements, for nine solid elements of atomic number ranging from 4 (Be) to 82 (Pb) and again good agreement between the data and the predictions of wave-mechanics theory was obtained. Absolute measurements of the scattering at 150° were made for graphite and aluminium and gave results differing only a few per cent from the theoretical values. It is shown that measurements of the proportion of modified radiation may be used to determine the atomic structure factor. Throughout the investigation, great attention was paid to the many possible sources of error, and to the estimation of necessary corrections. W. S. S.

1199. Structure of K Lines of Very Light Atoms. A. Hautot. *J. de Physique et le Radium*, 5. *pp.* 20–26, *Jan.*, 1934.—An improved spectrograph is described with which the fine structures of the K radiation of carbon, boron, and beryllium have been observed [see Abstracts 3650, 3651, 4560 (1933)]. The fine structure in the case of elements of atomic number $\nless 6$ is best explained by Wolfe's modification of Langer's scheme [see Abstract 1925 (1933)], which gives five satellites, α', α_{3-6}. In the case of carbon it has been impossible so far to separate α_3 from α_4, and α_5 from α_6. For elements lighter than carbon, in which the number of electrons is insufficient for this scheme, an explanation based on assumed mobility of electrons between atoms [see Abstract 487 (1931)] is not compatible with experimental results; but these are compatible with the observed lines being due to non-quantified forbidden transitions, *e.g.* $2s \rightarrow s$; in which case the L lines of Na, Mg, and Al will also correspond with an abnormal L radiation ($3s \rightarrow 2s$). C. A. S.

1200. Weak Lines in K-Spectrum of 48 Cd and 50 Sn. Part III. E. C. Ingelstam (formerly **Carlsson**). *Zeits. f. Physik*, 87. 5–6. *pp.* 283–290, *Jan.* 15, 1934.—Quadripolar transitions and other new weak lines in the K-spectrum of 48 Cd and 50 Sn. Discussion of methods employed. [See Abstract 4565 (1933).] A. D.

1201. Ultra-Soft X-Rays. M. Siegbahn and T. Magnusson. *Zeits. f. Physik*. 87. 5–6. *pp.* 291–309, *Jan.* 15, 1934.—Researches into the K- and L-series in ultra-soft X-rays carried out by the concave grating method. A. D.

1202. Natural Widths of L-Series Lines in X-Ray Spectra of Elements 74 to 83. J. H. Williams. *Phys. Rev.* 45. *pp.* 71–75, *Jan.* 15, 1934.—The full widths at half-maximum of the $L\alpha_1$, $L\beta_1$, $L\beta_2$ and $L\gamma_1$ lines of Bi, Pb, Tl, Au, Pt, Ir and W have been measured with Allison's double spectrometer in the (1, +1) position equipped with previously calibrated calcite crystals of high perfection. The results in X.U. are given in the table. The widths are uncorrected for the finite resolving power of the crystals or for the geometrical divergence of the X-ray beam. Approximate small corrections have been made for interfering lines. Relative wave-lengths of neighbouring lines are given. Empirical relations between the energy widths of the lines investigated and the atomic number and the electron transitions involved are suggested. The effects of alloys of the elements on the widths observed are discussed. AUTHOR.

Line	74 W	77 Ir	78 Pt	79 Au	81 Tl	82 Pb	83 Bi
$L\alpha_1$	1·26	1·19	1·17	1·13	1·11	1·05	1·03
$L\beta_1$	·943	·822	·804	·785	·743		·700
$L\beta_2$	1·38	1·17	1·14	1·06	1·00		·895
$L\gamma_1$	1·01	·923	·837	·791	·741	·698	·669

1203. L-Absorption Spectrum of Tellurium. J. G. Tandberg. *Arkiv f. Mat., Astron., och. Fysik, Stockholm*, 24*A*. No. 6. [4 *pp.*], 1933. *In German.*—Investigation of the *L*-absorption spectrum of tellurium and its various chemical compounds. Reference to earlier work on iodine [see Abstract 2108 (1924)]. A. D.

1204. Chemical Constitution and K-Absorption Spectra. Part II. O. Stelling. *Zeits. f. phys. Chem.* 24. *Abt.B.* 5–6. *pp.* 407–428, *Feb.*, 1934.—Further experiments [see also Abstract 691 (1934)] are described for unsaturated *cis-trans*-isomers of saturated diastereomeric substances, and for positional isomeric benzene derivatives. The dependence on configuration of X-ray absorption spectra may be of special interest, because it enables the determination of the energetic changes of separate atoms in the molecule while the absorption spectra of different atomic species are also measured. With data from molecular refraction, heats of combustion, and solubility, only an average value for the changes of the whole molecule or lattice are obtained. The K-absorption spectra of stereoisomeric organic chloro-compounds are found to be of the same type as those of inorganic chloro-compounds with non-ionic chlorine. The short wave lines are displaced towards shorter waves when the chlorine atoms are bound to the same carbon atom or if in unsaturated compounds the *cis*-group to the chlorine is carboxyl or chlorine. The nature of the *trans*-group appears to be of minor importance. Methyl in *cis*-position causes with respect to hydrogen or phenyl a very small displacement towards the longer waves. Positional isomeric benzene derivatives give similar displacements (*e.g.* chlorobenzoic acids and chloronitrobenzene). Diastereomeric dichloro- or chlorohydroxy-substituted compounds give different short-wave lines for meso and racemic forms. The dichlorosuccinic acids, the stilbene dichlorides, and the chloromalic acids are discussed at length. The long-wave line is constant for all saturated compounds but differs from the corresponding line for chlorine bound to the ethylene group. Nuclear substituted benzene derivatives give the same lines as ethylene compounds. H. H. Ho.

1205. X-Ray Diffraction by Gaseous Benzene Derivatives. W. C. Pierce. *J. Chem. Phys.* 2. *pp.* 1–5, *Jan.*, 1934.—The Debye method for the determination of interatomic distances in single molecules is applied to ortho and paradichlorbenzene. Results with monochlorbenzene are used to correct the scattering curves so as to isolate the Cl — Cl scattering. The resulting Cl — Cl curves show good agreement with theoretical curves constructed for distances of 3·0 and 6·25 Å, respectively. The measurements indicate a plane hexagonal benzene molecule with the chlorine atoms lying in or near the plane. AUTHOR.

1206. X-Ray Examination of Materials for Coarse Structure. W. E. Schmid. *A.T.M.* 3. *T*10–11, *Jan.* 31, 1934.—An account is given of the methods used in the radiographic examination of materials for coarse-structure (inclusions, flaws, cracks, etc.) and the principles underlying them. Ionisation methods, photographic methods, and screening methods are discussed and the difficulties and advantages are given in each case. J. T.

See also Abstract 1123.

HEAT.

CALORIMETRY.

1207. Measurements of the Specific Heats of Liquids by a Cooling Method. R. W. B. Stephens. *Phil. Mag.* 17. *pp.* 297–312, *Feb.*, 1934.—The method involves the measurement of the rate of cooling of a liquid when contained in a tube immersed in an ice bath. The tube should have a low thermal conductivity and in this instance it was composed of Bakelite-Dilecto. After calibrating the apparatus by using a number of liquids of known specific heat, the mean specific heats of benzene and toluene have been measured over the two temperature ranges 5 to 10° C. and 10 to 15° C. The values obtained are, for benzene 0·399 and 0·402 cal./gm.° C. at 12·5° and 8·0° C. respectively, and for toluene 0·390 and 0·386 cal./gm.° C. at 12·5° and 7·5° C. The thermal conductivity of Bakelite-Dilecto has been deduced from the experimental data, the value being $7 \cdot 47 \times 10^{-4}$ and $7 \cdot 62 \times 10^{-4}$ c.g.s. units at 7·5° C and 12·5° C. respectively. R. W. P.

See also Abstracts 917, 1214.

CONDUCTION.

1208. Heat Transfer for Fluids in Turbulent Flow in Pipes. R. Chandler. *Inst. Petroleum Technologists, J.* 20. *pp.* 51–72, *Jan.*, 1934. —The paper contains a comprehensive account of the theoretical and practical contributions which have been made in connection with heat transfer to or from liquids and gases when flowing in pipes. Owing to the variation of thermal conductivity, viscosity and specific heat with temperature the heat transfer is a function of the fluid temperature. The viscosity of some petroleum oils changes rapidly with change of temperature, and a method is given whereby this change, as well as the smaller variation in specific heat, may be allowed for when determining the heat transfer. R. W. P.

1209. Friction, Heat Conductivity and Diffusion in Gaseous Mixtures. Part XXIV. M. Trautz. *Ann. d. Physik*, 13. 8. *pp.* 833–866, *Dec.*, 1933.—A detailed discussion of the best procedure for obtaining, from observations on mixtures of gases, the friction coefficient η_{12} previously defined [see Abstract 3080 (1933)]. The temperature and other variations of the quantities involved are fully considered. The calculations of constants occurring in the Chapman-Enskog theory are reviewed, and full tables given showing the calculated values of these quantities, of molecular cross-sections, of η_{12}, and of the coefficients of interdiffusion for a number of pairs of gases, at various temperatures. J. P. A.

1210. Thermal Conductivity of Gas Mixtures. O. Riechemeier, H. Senftleben and H. Pastorff. *Ann. d. Physik*, 19. 2. *pp.* 218–224, *Jan.*, 1934.—The authors show that for the calculation of the thermal conductivity of a gas mixture, the appropriate conductivities of the component gases are those corresponding to the total gas pressure and not to the respective partial pressures. J. S. G. T.

1211. Effect of Accommodation on Heat Conduction through Gases. B. G. Dickins. *Roy. Soc., Proc.* 143. *pp.* 517–540, *Feb.* 1, 1934.—A modified "hot-wire" method is described, the experiments being

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conducted at a series of pressures sufficiently low for convection to be absent. Under these conditions a straight line is obtained when the reciprocal of the energy dissipated in the wire (corrected for radiation) is plotted against the reciprocal of the gas pressure. The intercept on the inverse energy axis gives the reciprocal of the energy actually lost by conduction and enables the thermal conductivity of the gas to be calculated, whilst the accommodation coefficient can be derived from the slope of the line. Results are given for He, A, H_2, CO, O_2, Air, N_2, N_2O, CO_2, SO_2, NH_3, the thermal conductivity being considered accurate to about 0·4 %. [See following Abstract.] R. W. P.

1212. Thermal Conductivity of Air between 0° and 100° C. S. W. Milverton. *Phil. Mag.* 17. *pp.* 397–422, *Feb.*, 1934. *Supplement.*—A similar method to that described in the preceding Abstract has been used. The radiation correction was determined independently by extrapolation of the heat transfer measured at a series of low pressure to zero pressure. The thermal conductivity of air was found to be 5810×10^{-8} and 7180×10^{-8} c.g.s. units at 0° and 80° C. respectively. R. W. P.

1213. Wiedemann-Franz Number, Thermal Conductivity and Thermoelectric Power of Tellurium. C. H. Cartwright. *Ann. d. Physik*, 18. 6. *pp.* 656–678, *Nov.*, 1933.—The electrical and thermal conductivities and the thermoelectric power of tellurium specimens (single crystals and polycrystalline material) were determined simultaneously by a special method, at room-temperature and at the temperature of liquid oxygen. The Wiedemann-Franz number for tellurium was found to have more than one hundred times the normal value. This is explained by assuming that the thermal conduction in tellurium is due chiefly to the bound atoms. In the cases of good conductors, thermal conduction by the bound atoms represents only a small proportion of the conduction due to free electrons. The estimated contribution to the coefficient of thermal conductivity due to bound atoms is found to be of the same order of magnitude for conductors and semi-conductors, and is about equal to the conductivity of non-conducting crystals such as Na Cl. W. S. S.

1214. Thermal Conductivity and Specific Heat of Thermal Insulators. P. Vernotte. *Comptes Rendus*, 198. *pp.* 57–59, *Jan.* 3, 1934.—The thermal insulator whose properties are to be investigated is used in the form of a cylindrical block with a hole drilled down its axis to receive the bulb of a mercury thermometer. The thermometer is heated and then placed in the hole, the bulb thus acting as a hot body supplying heat to the insulator. It is shown how observation of the temperature recorded by the thermometer can be used for determining the specific heat and thermal conductivity of the insulator. J. E. R. C.

See also Abstracts 912, 1207.

CONVECTION.

1215. Use of Oseen's Approximation in Problems of Heat Transfer. N. A. V. Piercy and R. J. Schmidt. *Phil. Mag.* 17. *pp.* 423–432, *Feb.*, 1934. *Supplement.*—The analysis of the convection of heat from a short body in a stream of fluid depends on the solution of the equation $u(\partial\theta/\partial x) + v(\partial\theta/\partial y) = (K/c)\nabla^2\theta$. The calculation of u and v necessitates an approximation to the equations of motion. That proposed by Oseen is $\nu\nabla^4\psi = U\nabla^2(\partial\psi/\partial x)$, the symbols having their usual meanings. The authors obtain a solution of this equation which is applicable to large and fairly small Reynolds numbers and which affords numerical results agreeing with experimental results obtained by Fage and Falkner relating to the convection of heat from thin heated platinum foils cooled by an air stream. J. S. G. T.

DILATATION.

1216. Volume Coefficients of Expansion of Several Gases at Pressures below 1 m. J. B. M. Coppock and R. Whytlaw-Gray. *Roy. Soc., Proc.* 143. *pp.* 487–505, *Feb.* 1, 1934.—By the use of a Callendar constant pressure air thermometer determinations have been made of the volume coefficients of expansion of ethylene, carbon dioxide, nitrous oxide, nitric oxide, carbon monoxide, dimethyl ether, and sulphur hexafluoride, at several pressures between the temperature limits of 25°–50° C. and 11°–48° C. respectively in two series of experiments. Measurements were made using two expansion bulbs, one of glass and the other of fused silica. Those for carbon dioxide, nitrous oxide and ethylene obtained in the glass vessel when extrapolated gave values for the coefficient at zero pressure markedly greater than the accepted value but those carried out in silica yielded results in close agreement with this constant. This discrepancy is shown to be due to the greater adsorption on glass than on silica surfaces and when easily condensable gases are used gives rise to appreciable errors. AUTHORS.

1217. "Reversible" Thermal Expansion of a Silica Brick. J. A. Sugden. *Soc. Glass Technol., J.* 17. *pp.* 378–382; *Disc.*, 382–383, *Dec.*, 1933.—The thermal expansion of a silica brick over the temperature cycle 20—700—20° was found to be not strictly reversible, but a small permanent expansion was observed. The extent of the permanent expansion rapidly decreased with each repetition of the cycle and a decreased expansion over the range 20—700° occurred during each successive heating. A simple quantitative relationship was found between the decrement iu expansion up to 700° and the corresponding permanent expansion. The mechanism of the expansion of an agglomerate is discussed in connection with the above relationship. AUTHOR.

See also Abstracts 880, 917, 927, 1287.

MELTING AND BOILING POINTS.

1218. Freezing-Point Curves of the Systems: $TiCl_4$-$SiCl_4$, $TiCl_4$-CCl_4, $TiCl_4$-$SnCl_4$, and $TiCl_4$-$SbCl_5$. N. Nasu. *Tohoku Univ., Sci. Reports,* 22. *pp.* 972–986, *Dec.*, 1933. *Report No.* 315 *from the Research Inst. for Iron, Steel and other Metals. In English.*—The freezing-point curves of the systems, $TiCl_4$–$SiCl_4$, $TiCl_4$–$SnCl_4$, $TiCl_4$–CCl_4, and $TiCl_4$–$SbCl_5$, have been determined by the method of both total and differential thermal analyses. In the system $TiCl_4$–$SiCl_4$ a liquidus occurs between the two components, constituting a eutectic point just on the melting point of $SiCl_4$, and with the systems $TiCl_4$–CCl_4 and $TiCl_4$–$SbCl_5$ liquidus curves of simple eutectic type have been found, while the system $TiCl_4$–$SnCl_4$ shows a couple of liquidus and solidus curves of simple solid solution type. AUTHOR.

1219. Freezing Points and Triple Points with Water. W. P. White. *Am. Chem. Soc., J.* 56. *pp.* 20–24, *Jan.*, 1934.—An ice-point apparatus is described which is constant to 0·0001° over long periods. The bath proper is fitted with tubes for washing and replenishing with pure water, the whole being protected by crushed ice against melting. By washing with chilled water impurities in the ice are removed from the surfaces, where alone they can affect the temperature, the accuracy of the bath depending solely on the purity of the water. Errors in a sealed triple-point bulb arise from transportation of impurity in the water, and can be overcome only temporarily. The triple point is less reliable than the ice point for continuous work. N. M. B.

1220. Transition Point of Carbon Tetrachloride as a Fixed Point in Thermometry. H. L. Johnston and E. A. Long. *Am. Chem. Soc., J.* 56, *pp.* 31–35, *Jan.*, 1934.—The transition and melting points of CCl_4 have been measured by an accurate procedure, and found to be $-47 \cdot 66(\pm 0 \cdot 05)^\circ$ and $-22 \cdot 87\ (\pm 0 \cdot 05)^\circ$, respectively. The transition has also been measured in a suspension of solid CCl_4 in MeOH and found to be in agreement with the value given above. Heats of transition and of fusion of CCl_4 have been measured calorimetrically, and found to be $1080 \cdot 8(\pm 3)$ cal./mole and $577 \cdot 2(\pm 1)$, cal./mole, respectively. The purity of the CCl_4 employed was tested by the measurement of heat capacities just below the melting point, the impurity not exceeding 1×10^{-3} mole %. The transition in solid CCl_4 was found to be both sharp and reproducible, and it is concluded that this transition provides a satisfactory secondary fixed point for the calibration of thermometric instruments; a simple procedure for employing it in practical laboratory standardisations is described. H. H. Ho.

1221. Boiling Point Curves of the Systems, $TiCl_4$–CCl_4, $TiCl_4$–$SiCl_4$ and $TiCl_4$–$SnCl_4$. N. Nasu. *Tokoku Univ., Sci. Reports,* 22. *pp.* 987–996, *Dec.*, 1933. *Report No.* 316 *from The Research Inst. for Iron, Steel and other Metals. In English.*—The boiling point curves of the $TiCl_4$–CCl_4, $TiCl_4$–$SiCl_4$ and $TiCl_4$–$SnCl_4$ systems have been determined by a new apparatus designed for the treatment of fuming liquids: the liquid and vapour curves obtained are of very simple form having no maximum or minimum and the maximum boiling intervals are 30°, 45°, and several degrees, respectively. In the analysis of the chloride mixtures fumes of titanium tetrachloride were prevented from escaping. AUTHOR.

1222. Production of Low Temperatures. E. Justi. *Zeits. f. Physik,* 87. 3–4. *pp.* 273–276, *Dec.* 23, 1933.—The author shows that the method suggested by Simon, which is based on the isothermal adsorption of H_2 by charcoal at the temperature of liquid air followed by adiabatic "desorption" from the thermally insulated material, is not a practical means of liquefying H_2. The use of Ne instead of H_2 does not result in the production of lower temperatures, nor is it possible to liquefy He by the "desorption" method. Somewhat similar experiments by Mendelssohn [See Abstract 2029 (1932)] have produced very low temperatures but it is pointed out that as initial pressures of from 1 to 10 atmospheres were used and the gas was removed by evacuating, the cooling probably resulted from expansion of the gas rather than from the "desorption." The "desorption" method presents a simple means of obtaining intermediate temperatures and should, therefore, enable the temperature scale at low temperatures to be improved. R. W. P.

1223. Inverted Fractional-Distillation Analysis. R. A. J. Bosschart. *Indust. and Engin. Chem.* (*Analytical Edition*), 6. *pp.* 29–33, *Jan.* 15, 1934.—A description is given of a rectifying apparatus for normal pressure, which allows analysis by distillation of mixtures of gases or liquids, commencing with the components with the highest boiling point.

The apparatus has a range of about + 200° to − 170° C. The fractions can be collected in liquid or in gaseous condition, as desired. The analysis can be terminated at any point, which shortens the duration of the analysis considerably in many cases, especially when determination of the fractions with the highest boiling points is of chief importance, which frequently happens in the petroleum industry. AUTHOR.

1224. Critical Test for the Purity of Gases. M. Shepherd. *Bureau of Standards, J. of Research,* 12. *pp.* 185–191, *Feb.,* 1934.—This paper reports a method by which the purity of gases (and liquids having normal boiling points below room-temperature) may be critically tested. The method involves one approximately isothermal distillation, whereby a small initial distillate, a middle cut, and a small final residue are obtained. The pressures of these three fractions are intercompared by means of a simple differential manometer and form the basis for indicating impurities of higher and lower boiling points than that of the approximately pure substance. The method eliminates the exacting temperature requirements of the widely used criterion of constancy of pressure during an isothermal condensation or vaporisation. At the same time, it offers more information than the isothermal condensation, and is suitable for testing mixtures containing more than two components. In many cases the order of magnitude of the impurities may be calculated. Like the isothermal condensation, it is not suitable for studying azeotropic mixtures. AUTHOR.

1225. Universal Ebullioscope. W. Swietoslawski. *Acad. Polonaise Sci. et Lettres, Bull.* 4–8 *A. pp.* 177–181, *April–Oct.,* 1933. *In French.* —A modified form of differential ebullioscope is described which is designed to meet the requirements of various experiments involving the determination of the boiling or condensation temperature of a liquid. Its applications include the determination of the purity of either a solvent or a dissolved substance. R. W. P.

1226. Improved Melting-Point Apparatus. Chao-Lun Tseng. *Chinese Chem. Soc., J. pp.* 143–182, *Dec.,* 1933. *In English.*—The apparatus is suitable for determining the melting points of organic compounds and is similar to one previously described by Mulliken. The substance under test is contained in a melting-point tube attached to a thermometer enclosed within a boiling tube surrounded by an outer flask. Only the dimensions of the flask and the thermometer have been modified. Comparative tests have been made with this and other types of apparatus using naphthalene, acetanilide, sucrose and carbazole. R. W. P.

See also Abstracts 930, 1316.

TEMPERATURE, MEASUREMENT OF.

See Abstracts 1183, 1219, 1220, 1222, 1232.

THERMOCHEMISTRY.

1227. Heats of Solution and Heats of Reaction in Liquid Ammonia. Parts I and II. C. A. Kraus, J. A. Ridderhof and R. F. Prescott. *Am. Chem. Soc., J.* 56. *pp.* 79–88, *Jan.,* 1934.—In Part I a description is given of a liquid ammonia calorimeter, in which heat effects are measured, in the main, by the amount of ammonia vaporised. Results are given for the heats of solution of 13 salts and of metallic sodium. For the salts, the values follow much the same order

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in ammonia as in water; but whereas in water the heats of solution are generally negative, in ammonia they are always positive except for potassium nitrate. Silver nitrate and lead bromide have very high heats of solution (22400 and 29800 cal. respectively). The value for sodium is about 1400. The heat effects accompanying a number of reactions are also determined. The heats of formation of various compounds, as calculated from the results obtained, are in fairly good agreement with the values in the literature. The heats of formation of Na_2S_2, Na_2Te and Na_2Te_2 are measured for the first time, by direct reaction of S or Te with Na in liquid ammonia. In Part II some improvements to the calorimeter are described, and the heats of solution of six more salts are measured.

L. A. W.

1228. Internal Equilibria and Partial Vapour Pressures of Mixtures of Primary Normal Alcohols with Normal Paraffin Hydrocarbons. G. v. Elbe. *J. Chem. Phys.* **2.** *pp.* 73–81, *Feb.*, 1934.—Heats of mixing of primary normal alcohols and normal hydrocarbons are always negative and the heat absorption per mol. of alcohol increases with dilution of the alcohols to the limiting value 5800 cal. per mol. In the pure liquid state, primary *n*-alcohols are completely associated to double molecules, and dissociate into single molecules when mixed with a hydrocarbon. The association is between the two hydroxyl groups of two single molecules on account of their electrostatic dipole forces. The observed heat absorption is due entirely to the dissociation of double molecules, and the equilibria between the single and double molecules are identical at equal molar concentrations for all primary *n*-alcohols in all *n*-hydrocarbons. The partial vapour pressures of *n*-alcohols in *n*-hydrocarbons is expressed by: $\log p = \log f - (\lambda - Q)/RT + B - b$, where p is the partial vapour pressure at the mol fraction f, λ the heat of vaporisation of the pure alcohol, Q the heat of mixing at mol fraction f and temperature I, and b a universal function of Q. B is determined by the simplified vapour-pressure equation, $\log P = -\lambda/RT + B$ and is constant over the whole temperature range investigated. λ and B depend on the nature of the alcohol, while Q and b depend on molar concentration and temperature. An equation has been developed which allows for the calculation of the degree of dissociation and hence of Q, for any temperature and concentration.

T. H. P.

1229. Rate of Heating of Wires by Surface Combustion. W. Davies. *Phil. Mag.* **17.** *pp.* 233–251, *Feb.*, 1934.—The experiments described in this paper were carried out with Pt, Pd, Au and Ag wires in mixtures of H_2, CO and air. The results obtained with the Pt and Pd wires appear to be in accord with Langmuir's theory of the process of catalytic oxidation of gases on solids. The surface conditions for maximum reaction velocities are established on these metals at comparatively low temperatures, and the effective rate of combustion is found to be governed by the diffusive and convective processes which limit the rate of transfer of the reacting gases to the surface of the wire. The concentration of the combustible gas at the surface of the wire is very greatly reduced during reaction owing to the slowness of diffusion, and this is found to have a very important bearing on the problem of the ignition of explosive gaseous mixtures by hot wires. In the case of Au and Ag wires there is no evidence of heating due to surface combustion in any mixture of H_2 and air or CO and air at temperatures below the ignition points of the gaseous mixtures.

H. H. Ho.

1230. Energy Relationships in the Dissociation of Water Vapour into its Atoms. O. Riechemeier, H. Senftleben and H. Pastorff. *Ann. d. Physik,* 19. 2. *pp.* 202–217, *Jan.,* 1934.—From results obtained by the dissociation of water vapour, in a mixture of the vapour and mercury vapour, by illumination with mercury radiation it is concluded that the heat tone (Q) of the reaction $H_2O \rightarrow H + OH$ corresponds to 5·11 ± 0·04 V, which is equivalent to 117·9 ± 0·9 k. cal./mol. The value of Q for the dissociation of OH according to the equation $OH \rightarrow O + H$ is 5·29 ± 0·14 V. J. S. G. T.

1231. Heats of Dissociation of Gaseous Alkali Halides from Thermal and Optical Data. H. Beutler and Hilde Levi. *Zeits. f. phys. Chem.* 24. *Abt. B.* 4. *pp.* 263–281, *Feb.,* 1934.—Since a recent determination of the dissociation energy of the gaseous alkali halides into free atoms can only be accurate within ± 1 to 2 k.cal. in consequence of the diffusity of the bands, a calculation has now been made using a cyclic process which involves thermochemical, physical, and optical measurements. The accuracy of the data obtained is quite as good as data obtained from the band spectra. The earlier calculations and measurements of the heats of dissociation of the salts are compared in tabular form with the new data. An appendix contains a calculation of the heats of sublimation of K and Li using the chemical constants, the values being 21·42 k. cal. (± 0·2 k.cal.) and 33·3 ± 0·8 k.cal. respectively. H. H. Ho.

1232. Temperature Gradient in Flames. O. C. de C. Ellis and E. Morgan. *Faraday Soc., Trans.* 30. *pp.* 287–298, *Feb.,* 1934.—The object of this paper [see Abstract 1128 (1933)] is to show that the characteristic thermochemical equation of the reaction in an explosion-flame is not completed near the surface of the flame. To this end it is demonstrated: (i) that unless there is delayed emission of heat the temperature must fall inward from the flame-surface throughout the flame-period; (ii) that actually the temperature rises inward from the flame-surface throughout the flame-period when the reactions considered lead to equilibria that shift exothermically under the condition of rising temperature and pressure, the rise in the gradient becoming more and more marked as the combustion proceeds; (iii) that for a considerable portion of the flame-period the temperature rises inward from the flame-surface even when the reactions considered lead to equilibria that shift endothermically under the condition of rising temperature and pressure. It is evident, then, that there is a lag on the completion of the primary action that is characteristic of the flame-surface in the mixture considered. The phenomenon of "after-burning," *i.e.,* the completion of the thermochemical equation, is demonstrated independently in another way. T. H. P.

See also Abstracts 876, 1179, 1220, 1241, 1268, 1315.

THERMODYNAMICS.

1233. Theory of Critical Phases. E. Jouguet. *Comptes Rendus,* 197. *pp.* 1705–1709, *Dec.* 26, 1933, *and* 198. *pp.* 218–222, *Jan.* 15, 1934.—The equilibria of heterogeneous mixtures have been closely investigated in recent years. In this mathematical paper, a number of theorems known to apply in special circumstances are shown to be particular cases of a general theorem similar to that of Maxwell, and relating to critical phases. The methods of Gibbs are employed in deducing this generalisation.

The theory is extended to the detailed study of stability and of critical points in heterogeneous mixtures. Further generalisations are deduced.
J. P. A.

1234. Physical Properties of Compressed Gases. Part IV. Entropies of Nitrogen, Carbon Monoxide and Hydrogen. W. E. and Lola S. Deming. *Phys. Rev.* 45. *pp.* 109–113, *Jan.* 15, 1934.—Continuing the applications of the authors' graphical method of computation [see Abstract 4433 (1932)] the entropies of N_2, CO, and H_2 are investigated. The entropy is represented as a function of the pressure for a series of isothermals, in a number of curves and in tables. The results are discussed with reference to the properties of an ideal gas, in which the entropy changes would always be smaller than those found. The results suggest that N_2, CO and H_2 cannot be reduced to a state of zero entropy by application of pressure. J. P. A.

1235. Thermodynamic Constants of Chlorine Monoxide. D. M. Yost and R. C. Felt. *Am. Chem. Soc., J.* 56. *pp.* 68–69, *Jan.*, 1934.—The partial vapour pressures of Cl_2O above its CCl_4 solutions have been measured at 25·0° C. and 0·0° C. The constants of Henry's law ($p_{mm.}/N$) are found to be 1830 and 662 respectively. The results combined with those of other investigators lead to the free energy equation $Cl_2(g)+\frac{1}{2}O_2(g)=Cl_2O(g)\ \Delta\ F^{\circ}_{298}=21{,}210$ cal. The entropy of Cl_2O gas at 25° C. and 1 atmosphere pressure is 67·9 cal./deg. J. S. G. T.

1236. Heat Capacity and Entropy of Potassium Chlorate from 13 to 300° Abs. Entropy of Chlorate Ion. W. M. Latimer, P. W. Schutz, and J. F. G. Hicks, Jr. *Am. Chem. Soc., J.* 56. *pp.* 88–89, *Jan.*, 1934.—The heat capacity of $KClO_3$ is measured from 13 to 300° Abs., and the curve of Cp against log T integrated graphically. The entropy at 298·1° Abs. of the salt is evaluated at 34·17 units. The entropy of the chlorate ion is calculated to be 39·3 and the free energy of formation 3700 cal., both at 25° C. L. A. W.

1237. Calculation of Thermodynamic Quantities from Spectroscopic Data for Polyatomic Molecules. Free Energy, Entropy and Heat Capacity of Steam. A. R. Gordon. *J. Chem. Phys.* 2. *pp.* 65–72, *Feb.*, 1934.—The methods already developed by Gordon and Barnes [see Abstract 3112 (1933)] for computing thermodynamic quantities from the band spectrum of a diatomic molecule are extended to deal with the case of the triatomic unsymmetrical rotator. The free energy, entropy and heat capacity of steam are computed for the temperature range 298·1–1500° K. from the spectroscopic data of Mecke and his associates. From the free energy so calculated, the known spectroscopic free energies of CO, CO_2 and H_2, and the thermal data of Rossini, revised values of the equilibrium constant for the water-gas reaction are computed. The numbers so obtained are in close agreement with the experimental results of Neumann and Koehler and of Emmett and Schultz. AUTHOR.

1238. Entropies of Aqueous Ions. W. M. Latimer, P. W. Schutz and J. F. G. Hicks, Jr. *J. Chem. Phys.* 2. *pp.* 82–84, *Feb.*, 1934. —A critical survey has been made of existing data on the heats, free energies and entropies of reactions involving aqueous ions. These data lead to remarkably consistent values for the ionic entropies. The entropies of 20 positive ions and 12 negative ions have been tabulated. AUTHORS.

1239. Free Energy of Formation of Lead Amalgams. C. S. Hoyt. *Univ. Pittsburgh, Bull.* 30. *pp.* 159–165, *Nov.*, 1933.—Potentials of Pb/Pb amalgam concentration cells were measured. Free energy of formation of amalgams has been determined and the heat of solution of lead in dilute amalgam calculated from the temperature coefficient of the e.m.f. A. S. C. L.

1240. Temperature Coefficients of the E.M.F. of the Cell Cd (Metal), CdSO$_4$, Cd (Saturated Amalgam). W. G. Parks and V. K. La Mer. *Am. Chem. Soc., J.* 56. *pp.* 90–91, *Jan.*, 1934.—E.m.f. measurements are made on the cell Cd (metal), CdSO$_4$, Cd (2-phase amalgam) at 10° intervals between 0 and 30° C. From the results obtained the changes of free energy, entropy and heat content are calculated for the process Cd (metal) → Cd (solid, saturated with Hg). These data are combined with the data available in the literature in a calculation of the same thermodynamic quantities for the process Cd (solid) + PbSO$_4$ (solid) → CdSO$_4$ (unit activity) + Pb (solid). A comparison is made of the heats of formation of cadmium amalgams as calculated from e.m.f. and thermal measurements. L. A. W.

1241. Piezochemical Equilibria. E. Cohen and K. Piepenbroek. *Zeits. f. phys. Chem.* 167. *Abt.A.* 5–6. *pp.* 365–393, *Jan.*, 1934.—This paper studies the influence of pressure upon the chemical equilibrium in condensed systems and provides a quantitative experimental proof of the Planck equation $(d \log K/dp)_T = -\Delta V/RT$, where K is the chemical equilibrium constant. For this purpose the pressure coefficient of the equilibrium constant has been evaluated by an indirect method which is fully described. The reaction chosen was: Tl Cl (solid) + CNS ⇌ Tl CNS (solid) + Cl, and this was studied in the reversible cell: Tl-amalgam, | Tl CNS-KCNS, | KCl-Tl Cl, | Tl-amalgam. The value of the equilibrium constant for given pressures and temperatures was controlled by means of the van't Hoff reaction isochor and, for this purpose, the thermal changes were also evaluated electrically. H. H. Ho.

1242. Modification of Brillouin's Unified Statistics. R. B. Lindsay. *Phil. Mag.*, 17. *pp.* 264–271, *Feb.*, 1934.—Brillouin's unified aspect of statistical formulæ following (A) classical, (B) Bose-Einstein, (C) Fermi-Dirac, reasoning depends upon a certain parameter a. If $a=0$, type (A) is reached; $a=-1$ leads to (B) and $a=+1$ to (C). The present paper allows greater latitude to a, but does not attempt a discussion of the physical significance. A number of properties, such as entropy, are calculated on this basis. F. I. G. R.

See also Abstracts 896, 897, 1194, 1209, 1287, 1307, 1313.

VAPOUR PRESSURE.

1243. Argon-Neon Mixtures. P. Clausing. *Physica*, 13*e*. 10. *pp.* 320–333, 1933.—Points out certain difficulties in ascertaining the concentration of A in A-Ne mixtures and suggests methods for dealing with these. A. D.

See also Abstracts 1224, 1228, 1235.

ACOUSTICS.

1244. Sounds from a Dihedral. Z. Carrière. *Rev. d'Acoustique*, 2. *pp.* 333–357, *Sept.*, 1933.—An experimental investigation of the sounds obtained when a laminar jet of air is delivered upwards and allowed to impinge against the apex formed by two sheets of material in the shape of an inverted V. The jet was impregnated with smoke and when viewed stroboscopically was seen to oscillate from side to side, the frequency of oscillation being proportional directly to its speed and inversely to the distance between the orifice from which the jet emerged and the apex of the dihedral: the frequency also increased as the angle between the faces of the dihedral decreased. The variations introduced by making the sides of the dihedral unequally inclined to the vertical; the line of intersection of the faces inclined to the horizontal; and replacing the straight sides by semi-cylinders, are noted. The matter is further elucidated by experiments in which the dihedral is suspended so that it may oscillate.

E. J. I.

1245. Filtration of Elastic Waves in Rods. R. B. Lindsay. *Acoustical Soc. of America, J.* 5. *pp.* 196–201, *Jan.*, 1934.—The theoretical studies previously made on the filtration of compressional waves in rods by Lindsay and White have been extended to the case of torsional waves in a rod and of compressional waves in rods having side branches. If an infinite cylindrical rod is loaded at equal intervals of length $2l$ with discs (having planes perpendicular to the rod) of mass m and moment of inertia I about the axis of the rod, the resulting structure is found to act as a low-pass filter for torsional waves. The transmission bands are given by the condition $+1 \gg \cos W \gg -1$, where

$$\cos W = \cos 2kl - \omega I/\pi a^4 \rho_0 c \cdot \sin 2kl.$$

Here $k = \omega/c = 2\pi\nu/c$, where ν is the frequency of the waves. The velocity of propagation $c = (\mu/\rho_0)^{\frac{1}{2}}$, where μ = rigidity modulus and ρ_0 is the mean density of the rod. The radius of the rod is a. For given I, increase in l decreases both the cut-off frequency of the first transmission band as well as the upper limit of the first attenuation band. For given l, increase in I decreases the cut-off frequency. There is next considered the case of an infinite cylindrical rod loaded at equal intervals of length $2l$ with perpendicular side rods of length l_s. The approximate assumption is made that longitudinal compressional waves in the main rod set up transverse flexural waves in the side rods. Calculation indicates that if the side rods have *free* ends the structure acts as a low-pass filter for compressional waves in the main rod. If on the other hand the side rods have rigidly clamped ends, the structure under suitable choice of dimensions (in particular $l/l_s \gg 1$) can act as a high-pass filter. Numerical illustrations are given. [See following Abstract.]

AUTHOR.

1246. Acoustic Filtration in Non-Homogeneous Media. R. B. Lindsay, C. R. Lewis and R. D. Albright. *Acoustical Soc. of America, J.* 5. *pp.* 202–205, *Jan.*, 1934.—This paper considers theoretically the propagation of compressional waves in a structure consisting of an infinite series of alternating layers of two different media which may be either fluid or solid. It is shown that such a structure acts as a low-pass acoustic filter. A number of special cases are computed and it is found that the cut-off frequency depends essentially on the section length and the relative impedance of the media. The problem is shown to be mathematically quite

analogous to that of the propagation of acoustic waves in air through an infinite tube containing alternate constrictions and expansions. Moreover the loaded solid filter considered in a previous paper by Lindsay and White [see Abstract 675 (1933)] proves to be a limiting case of the non-homogeneous medium filter of the present article. [See preceding Abstract.]
AUTHORS.

1247. Velocity of Sound by the Acoustic Interferometer. E. Grossmann. *Phys. Zeits.* 35. *pp.* 83–88, *Jan.* 15, 1934.—In work with the acoustic interferometer in which a piezo-quartz is used with a reflector, the intervals between the positions of the reflector for maximum reaction on the sender are not always exactly equal to a half wave-length, but show deviations which depend on the distance between sender and reflector. Neglect of these deviations in a determination of the velocity of sound leads to error. In the present work the author has derived, from the form of the sound field near a vibrating circular membrane, an approximate formula for the magnitude of the intervals as dependent on the distance between sender and reflector.
G. E. A.

1248. Audibility of the Detonations of a Semi-Volcanic Steam Explosion in Sumatra. H. P. Berlage, Jr. *Gerlands Beitr. z. Geophys.* 40. 4. *pp.* 369–370, 1933.—On June 24th, 1933, at 21h. 54m. 35s. G.M.T. a violent earthquake took place in South Sumatra. In consequence the activity of a certain fumarole field was heightened, and this action culminated in a series of very violent explosions, especially at daybreak on July 10th. The detonations of July 10th were heard at great distances, and a map shows the stations from which the explosions were reported as having been heard. These extend 660 km. to Keboeman in Java on one side, and 550 km. to Kuala Tungkal in Sumatra. A window pane was smashed in Batavia (305 km.) in a zone of good audibility. An inner zone of radius 170 km. round the centre of explosion was marked by very poor audibility, and at places beyond this zone the sound appeared to come down to the observers.
G. E. A.

1249. Propagation to Great Distances of Air Waves from Gunfire. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* 60. *pp.* 80–88, *Jan.*, 1934.—The object of the experiments, which are the picking up by Tucker microphones of the sound from distant firing, usually at Woolwich, is to investigate the properties of the upper air. It is generally found that the waves take so long on their journey that they must have made a long detour through the upper atmosphere. The result of the experiments gives an estimate of the temperature in regions in the atmosphere for which no other method has been found, up to the present. Maps show places in England, to which sounds have been carried on various occasions, and diagrams shows the calculated temperature and velocity of sound with height in the atmosphere.
H. M. B.

1250. Refraction of Light by Ultrasonic Waves. R. Bär. *Helv. Phys. Acta,* 6. 8. *pp.* 570–580, 1933. *In German.*—Spectra were obtained and figured. The intensity of the spectra is a function of an ordinal number which presents maxima and minima, the position of which depends on the intensity of the ultra-sound on the ratio {ultra-sound wave-length/light wave-length} and on the distance the light travels in the ultra-sound region. Refraction in ultra-sound regions also investigated in liquids, as well as reflection and refraction of ultra-sound waves at the surface between two liquids.
A. D.

1251. Absorption of Supersonic Waves in Mixtures of Air and Carbon Dioxide at Different Relative Humidities. H. H. Rogers. *Phys. Rev.* 45. *pp.* 208–211, *Feb.* 1, 1934.—The absorption of supersonic waves of frequency 409.6 kc./sec. in mixtures of air and CO_2 at eight relative humidities ranging from 10 to 75 % was measured. The source of the radiation was a quartz crystal oscillator. The receiver was an acoustic radiometer of the torsion vane type. Curves of the logarithm of the radiometer readings as a function of distance between radiometer and crystal face were straight lines the slopes of which gave the absorption constant k. The absorption constant k is a linear function of the per cent of CO_2. For a given mixture of air and CO_2 it is a nonlinear function of the relative humidity increasing to a maximum of 45 % and then dropping off rapidly. The values of k are given in a table in the original. AUTHOR.

1252. Origin of Sounds Emitted by Airscrews. J. Obata, S. Morita and Y. Yosida. *Tokyo Univ. Aeronaut. Research Inst., Report, No.* 99. *pp.* 101–114, *Dec.*, 1933. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 513–516, *Dec.*, 1933. *In English.*—Model airscrews one-third of full size were rotated, and the pressure variation close to the blade before and after the blade had crossed the front of a microphone was recorded by means of a condenser microphone, amplifier and oscillograph. At the front of the blade the initial impulse is suction, which changes to pressure as soon as the blade crosses the front of the microphone. On the reversed side pressure precedes suction. In the plane of rotation the only impulse is suction. For a rod with cross-section of stream-line form, the pressure variation on both sides of the blade and in the plane of rotation is similar to that on the front side of the airscrew blade. The magnitude of the variation is largest on the front side of the blade, and smallest in the plane of rotation, the variation being greatest at a point about one-sixth of the length of the blade from the tip. With regard to the sounds produced, close to the blade the effect is due only to one blade; at about two metres distance, the wave-form is much distorted, second harmonics being prominent. At distances greater than five metres, the airscrew as a whole becomes a source of sound with a wave-form resembling a sine curve. G. E. A.

1253. Structure of the Voiced Sounds in Speech. W. Lenk. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp.* 313–323, 1933.—A sound-film apparatus was used in examining the sound curves produced by normal speech and song, and by the speech of pathological subjects. Strict periodicity is always absent from the records and the beginning of a vowel always exhibits great irregularity of periodic time. As elements in the structure of voiced sounds, damped vibrations are of importance which are caused by impulsive excitation of the mouth and throat cavities. Quasi-periodic vibrations are produced by a succession of impulses, and the rhythm of repetition is given by the self-interrupting mechanism of the glottis which determines the pitch of the speech sounds. The conclusions confirm those of Scripture on the physical nature of the vowels. G. E. A.

1254. Influence of Phase on Tone Quality and Loudness. Interference of Subjective Harmonics. E. K. Chapin and F. A. Firestone. *Acoustical Soc. of America, J.* 5. *pp.* 173–180, *Jan.*, 1934.—A strong 108 cycle fundamental and one of its harmonics were impressed on one ear in various relative phases and sound pressures. The tone quality and the loudness of the combination were found to depend on the relative phase of the two components. In a certain phase relation the loudness of the combination was 3·5 db less than the loudness of the fundamental alone: varying the phase changed the loudness of the combination by about 10 db. The above observations may be explained by assuming that the ear mechanism distorts the pure components of a complex sound pressure, producing subjective harmonics which may either constructively or destructively interfere depending on the relative phases of the components. Some evidence was found in support of an assumption that the subjective harmonics due to a single l.f. pure tone actuating the ear, are in phase as cosine functions without epoch angles. AUTHORS.

1255. Two-Field Stroboscope. P. F. Gaehr. *Science,* 77. *pp.* 412–413, *April* 28, 1933.—The case of a vibrating string of which two contiguous portions are alternately illuminated stroboscopically is considered. The laws for either field are easily derived from the laws of a rotating disc with one spot. If the flash-frequency of either field is taken as F, and that of the string as S, and if $F = Sf/s$, then (1) the number of lines seen in either field is f, and when two lines merge into one, that one must be counted twice; and (2) if s is even, the two fields are identical; and if s is odd, they are similar. The two-field stroboscope makes frequency measurements simpler, it greatly facilitates detection of resonance, and tends to make microscopic observation of the string unnecessary in cases where resonance is to be detected. [See also " Stroboscopic Frequency-Meter," by L. B. Arbimbeau in the *General Radio Experimenter,* Nov., 1930]. AUTHOR.

1256. Mechanical Wave Model Illustrating Acoustic and Electrical Phenomena. G. D. West. *Phys. Soc., Proc.* 46. *pp.* 186–192; *Disc.,* 192–195, *March,* 1934.—A mechanical model is described which illustrates a band-pass filter. The model consists of a series of equal masses suspended on equal lengths of straightened watch-spring from a rigid bar. Through holes bored in the masses, which are equally spaced, is threaded a piece of elastic. One end is fixed and the other can move with a simple harmonic motion, communicated by means of a rocker arm attached to a small motor. Wave-transmission along the system takes place only if the frequency falls within a certain range. Very high and very low frequencies are not transmitted. The theory of the model is discussed, and various analogies to physical phenomena are pointed out. AUTHOR.

See also Abstracts 936, 1349.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See **Abstracts 1256, 1274, 1304.**

CONDUCTION AND DISCHARGE IN GASES.

1257. Propagation of Energy in Tubes of Ionised Gas. T. V. Ionescu. *Comptes Rendus,* 198. *pp.* 353–355, *Jan.* 22, 1934.—In a previous paper [see Abstract 3198 (1931)] it was shown how to calculate the velocity of propagation of energy in tubes of ionised gas by means of the classical formula $U = (LC)^{-\frac{1}{2}}$, where L represents the self-inductance and C the capacity of the tube per unit length. To calculate C for a tube of circular section it is assumed (1) that the quantity of electricity which appears in a given section of a tube of ionised gas is distributed on the surface and (2) that the distribution of electricity across the section of the tube follows a law $\rho = f(R)$. If ρ is approximately constant an expression can be found for U, and this is done for the case of a metal tube. Experiments are described which appear to confirm the theory advanced.

A. W.

1258. Theory of Ionisation Measurements in Gases at High Pressures. D. E. Lea. *Cambridge Phil. Soc., Proc.* 30. *pp.* 80–101, *Jan.* 31, 1934.—Jaffe's columnar theory to account for the recombination of ions in α-particle tracks is extended to β-rays by taking account of the clusters of secondary radiation. General agreement with experiment was found. Recombination in proton tracks produced in H by neutrons is in agreement with the columnar theory, but in the case of N nuclear tracks in N the recombination is only 1/100th of that predicted by the theory. It is suggested that recombination is likely to be abnormally small for all heavy nuclei of velocities not exceeding 5×10^8 cm. per sec. The coefficients of recombination of ions in N and H experimentally determined at pressures of 20, 40 and 90 atmospheres are given. The results are shown graphically as well as in tables. J. J. S.

1259. Discharge Phenomena in Oscillating Circuits. W. Krug. *Phys. Zeits.* 34. *pp.* 76–82, *Jan.* 15, 1934.—The conditions obtaining in a simple oscillating circuit comprising a condenser, inductance, resistance and spherical discharge knobs (in air at atmospheric pressure) are investigated with the aid of a kathode-ray oscillograph. Potential-time curves for the inductance show several discontinuities. The relation between the critical discharge potential and the time of discharge is examined, and it is shown that the potential remains constant at 425 V for from 4 to 10×10^{-6} sec., but for times exceeding this the potential rises linearly with time. The results are briefly discussed. H. J. H. S.

1260. Spark Discharge in Air Containing Suspended Particles. S. Franck. *Zeits. f. Physik,* 87. 5–6. *pp.* 323–339, *Jan.* 15, 1934.—A study was made of the sparking potential between electrodes of different shapes (*a*) when one of the electrodes was covered with a layer of powder (lycopodium, graphite, cement, zinc oxide, etc.), (*b*) when the air between the electrodes contained the powder in suspension. The effect of powder on the electrode was much greater than that of the suspended powder. For lycopodium, the sparking potential between a plane (positive) and a point (negative) was reduced to one-third its normal value by covering the plane with a 2 to 4 mm. layer of powder. Different materials reduced the sparking potential by varying amounts depending on their electrical conductivity. The investigation bears on the maximum potential which can safely be applied in the so-called electrical gas cleaning process without danger of dust explosions. W. S. S.

1261. Experimental Study of Electric Discharge. I. C. Purcaru. *Comptes Rendus,* 198. *pp.* 158–160, *Jan.* 8, 1934.—The object of the work here described was to study the condenser spark discharge for low capacity values and to investigate the structure of the corresponding spark. The electrodes used were usually of zinc and were of ellipsoidal shape. Photographs were taken on a rapidly revolving disc. Capacities much smaller than those used by Schuster and Hemsalech were employed (0·00284 to 0·013 μfd.) and this combined with a high film speed (180 to 200 m./sec.) enabled the author to show that under the conditions used the spark has a structure more complex than was found by Schuster and Hemsalech. The partial sparks of each discharge could also be sharply separated. The spark is generally composed of an initial discharge followed by a series of partial sparks. The initial discharge is found to be made up of many sparks following one another very rapidly. Variation of the resistance, inductance, or capacity of the discharge circuit produces radical modifications of the spark characteristics. A. W.

1262. Deviations from Paschen's Law. S. P. McCallum and L. Klatzow. *Phil. Mag.* 17. *pp.* 291–297, *Feb.,* 1934.—Using parallel plate electrodes at various distances apart measurements have been made of the sparking potential in various gases. For diatomic gases and helium, in which the lateral diffusion of the electrons is known to be small, Paschen's law is valid, but for the heavier monatomic gases argon, neon and krypton, in which the lateral diffusion is large, deviations occur, the sparking potential only being proportional to the quantity of gas between the plates when their distance apart is small compared with their area. The results obtained have an important bearing on the design of apparatus for the measurement of sparking potentials and photoelectric currents in these gases. R. W. P.

1263. Gaseous Discharge with Diffusion and Transverse Force. Least Cross Section and Least Current Strength of the Discharge. W. Fucks. *Zeits. f. Physik,* 87. 3–4. *pp.* 139–153, *Dec.* 23, 1933.—Equilibrium conditions for a stationary burning gas discharge have been adduced from consideration of the lateral migration of particles from the discharge path on account of diffusion and the influence of a transverse electric field. The minimal cross-section and current strength can be calculated approximately. Both the cross-section and the current strength are related to the pressure. Limiting cross-section varies inversely as the pressure; but limiting current strength to a first approximation appears to be independent of pressure. W. R. A.

1264. Broadening of the Positive Column. R. Hellmann. *Zeits. f. Physik,* 87. 5–6. *pp.* 277–282, *Jan.* 15, 1934.—The broadening of the positive column of a discharge functioning in the neighbourhood of its minimal current strength is discussed qualitatively and quantitatively. A strict theoretical treatment of the problem does not appear to be possible, but by making certain assumptions it is possible to obtain satisfactory agreement between the theoretical results and those found experimentally for molecular and rare gases. The observed characteristics of the positive

V. 19

column give a plausible explanation of the fact that in the molecular gases, in contrast to the rare gases, with a decreasing discharge current the potential shows a marked increase. A. W.

1265. Control and Quenching of Glow Discharge in a Tube with Gauze Kathode and a Third Electrode. E. Badareu. *Zeits f. techn. Physik*, 14. 12. *pp.* 540–543, 1933.—A further investigation was made of the effects in tubes with gauze kathodes and a third electrode previously described by Güntherschulze and Keller. [See Abstract 947 (1932).] The discharge characteristics were determined for different values of the control potential, and experiments were made to determine the effect of the distance between the kathode and auxiliary electrode on the phenomena. The results obtained offer an explanation of the phenomena. It appears that secondary electrons are produced by the auxiliary electrode and, in the canal-ray space, pass into the principal discharge space and there give rise to a sort of subsidiary excitation whose magnitude varies with the potential on the auxiliary electrode, and hence affects the main discharge. A. W.

1266. Deposits of Elements by H.F. Discharge. D. Banerji and D. Bhattacharya. *Phil. Mag.* 17. *pp.* 313–316, *Feb.*, 1934.—In the study of the deposits of mercury by h.f. discharge [see Abstract 2536 (1933)], the formation of the deposit is probably due to the potential gradient between the axis and the walls. Thus it is to be expected that positive ions will form deposits at different positions in the tube from negative ones. Experiments using K and Hg for positive ions and S and I for negative ions confirm the hypothesis. Further, results show that the distance between the deposits formed on either side of the electrodes decreases with the increase of atomic weight of the element, this is true for both sleeve and ring electrodes. H. M. B.

1267. Ionisation Potential of Fe II. J. C. Dobbie. *Phys. Rev.* 45. *pp.* 76–78, *Jan.* 15, 1934.—Two new high terms, e^6D and e^4D, have been found in the spark spectrum of iron which are in series with known low terms. The principal ionisation potential for Fe II is thus found to be 16·16 volts. AUTHOR.

1268. Ionisation Potentials and Energies of Formation of Non-Polar Molecules. J. Savard. *J. de Physique et le Radium*, 5. *pp.* 27–36, *Jan.*, 1934.—In a former publication [see Abstract 265 (1934)] the author proposed the expression: $D = 2nI_m - \Sigma n_a I_a$ volts for the combining energy D between atoms united by the same bond of $2n$ electrons, where I_m is the ionisation of the molecule (principle of Franck and Condon), I_a is that of the atom, and n_a is a simple whole number, $2n = \Sigma n_a$. The following molecules have now been investigated, viz., HCl, Cl_2, SO_2, the radical SO, C_2N_2 and the radical CN, HCN, C_2, CH_4 and the radical CH_3,C_2H_4 and the energy of the double bond, C_2H_2 and the energy of the triple bond, and C_6H_6. For molecules of the type R − R, it is found that the bonding energy of monovalent radicals is equal to twice the difference between the ionisation potential of the molecule and that of the radical for CN, CH_3, CH_2, etc., and that the ionisation potential of the radical is equal to that of the carbon atom. The bond energies for carbon are given by: simple bond, $B_1 = 2(I_m - I_c)$; double bond, $B_2 = B_1 + 2(I_m - I_c)$; triple bond, $B_3 = B_1 + B_2 + 2(I_m - I_c)$. Satisfactory agreement is found between these data and the thermodynamic values. [See also *Comptes Rendus*, 198. *pp.* 751-753, *Feb.* 19, 1934]. H. H Ho.

1269. Passage of Slow Positive Ions through Highly Rarefied Gases. O. Beeck. *Phys. Zeits.* 35. *pp.* 36–52, *Jan.* 1, 1934.—A brief account of the cross-section measurements of gas molecules with respect to slow ions, namely protons, H_2^+-ions, H_3^+-ions, alkali-ions and argon ions. The neutralising cross-section (*Umladequerschnitt*) is discussed in relation to the ionisation potential and the ionic velocity. An account is also given of the methods used and results obtained in determining the probability of ionisation and excitation by means of positive ions. H. L. B.

1270. Achromatic Electron Lenses. M. v. Ardenne. *Zeits. f. Physik*, 86. 11–12. *pp.* 802–809, *Dec.* 7, 1933.—An investigation is made of the conditions involved in calculating achromatic combinations of magnetic and electric fields for streams of electrons. It is found that either two electric fields or one electric and one magnetic field suffice for the purpose. Simple formulæ are obtained for both converging and diverging " lenses," that is, combinations of fields. A magnetic diverging lens is also described. Equations are given which define the action of the lenses. H. L. B.

1271. Electric Electron Lens for Kathode-Ray Tubes. M. Knoll. *Arch. f. Elektrot.* 28. *pp.* 1–8, *Jan.* 17, 1934.—Different electrode arrangements are described which enable magnetic concentrating coils to be replaced by electric electron lenses and which may be used to obtain either small luminescent spots or relatively large divergence of the kathode beam. Electron microscope pictures obtained with such electric lenses are reproduced, and the application of the results to the technical construction of kathode-ray tubes is discussed. Electric lenses have the advantages of great simplicity, negligible current consumption and wide applicability on account of the free choice of the electrode potentials. By using ring-shaped or cylindrical electrode systems the equivalent of any type of optical lens can be obtained by suitable spacing and choice of potentials. With plate electrodes it is easily possible to obtain the equivalent of an optical cylindrical lens. A. W.

1272. Behaviour of Electron Tube Counters. C. Bosch. *Ann. d. Physik*, 19. 1. *pp.* 65–98, *Jan.*, 1934.—Preliminary experiments showed that the production of surges in a tube counter depended on the purity of the electrodes and the nature of the gas present. If the electrodes were carefully cleaned by heating and outgassing, a steady current free from surges was obtained with He, H_2, N_2 or dry oxygen in the tube. It was essential to remove all traces of water vapour. No conclusions as to the behaviour of a tube when surging could be deduced from its " static " characteristics. A tube was eventually constructed with Au electrodes and a He filling. At pressures of 2, 4, 6, 8 and 12 mm. of Hg no trace of surging was observed with this tube under any conditions, even when different condensers and resistances were connected in the tube circuit. Reversal of polarity merely produced a change in the initial potential at which a pure, continuous glow discharge commenced. Surges were eventually produced when the electrodes were reduced in area below a certain minimum value; platinum points were first used, but very fine Au wires showed similar behaviour. The results are explained in terms of a positive space charge, and the working of a normal tube counter is considered to be due to surges originating from sensitive patches on the surface of the impure electrodes. F. C. C.

See also Abstracts 876, 950, 951, 1091, 1121, 1134, 1159, 1167, 1183, 1331.

CONDUCTION IN SOLIDS AND LIQUIDS.

1273. Valve Voltmeter. M. Robert and R. Ozoux. *Comptes Rendus,* 198. *pp.* 62–64, *Jan.* 3, 1934.—By suitably adjusting the operating conditions of a screened-grid valve it has been found possible to obtain a parabolic relationship between its anode current and its grid potential. The change in anode current due to an alternating e.m.f. applied to the grid is therefore proportional to the square of the effective value of this e.m.f. and is independent of its wave-form and frequency. J. E. R. C.

1274. Measurement of Specific Resistance by Eddy-Current Shielding. W. B. Kouwenhoven and G. P. Daiger. *Rev. Sci. Instruments,* 5. *pp.* 94–101, *Feb.,* 1934.—Change of inductance of a solenoid which takes place when conducting material is brought into its field is caused by the eddy currents set up in the material by the alternating magnetic field of the solenoid. These eddy currents reduce the inductance of the solenoid. Eddy-current shielding is a function of the resistance and permeability of the material and the frequency of the supply. If the permeability is constant and known and the frequency known then the specific resistance may be calculated from the change in inductance produced by eddy currents in the core. In practice the method is both quick and simple. The bar whose specific resistance is required is inserted in a solenoid and the resulting change of inductance measured by an a.c. bridge. The only precautions necessary are the accurate centring of the bar in the solenoid and that it shall be of sufficient length to project from each end of the coil by a distance equal to twice the diameter of the coil. R. L.

1275. Adjustment of the Temperature Coefficient and Resistance of Low-Valued Resistance Standards. F. Wenner and J. L. Thomas. *Bureau of Standards, J. of Research,* 12. *pp.* 147–154, *Feb.,* 1934.—It is shown (1) that the temperature coefficient of low-valued resistance standards, which are of the 4-terminal type, may be either larger or smaller than the temperature coefficient of the resistance material used in their construction; (2) that in many cases it is possible to adjust the temperature coefficient to a practically zero value at a selected temperature; and (3) that the resistance may be decreased without the addition of a shunt, and without disturbing brazed connections between the resistance material and the copper terminals. AUTHORS.

1276. Action of Rectifiers. W. C. van Geel and H. Emmens. *Zeits. f. Physik,* 87. 3–4. *pp.* 220–230, *Dec.* 23, 1933.—A general discussion of the theories on the action of rectifiers. Measurements made with electrolytic rectifiers are given. The results may be explained on the assumption that in such rectifiers, as in others, the rectification is due to the fact that the metal and the electrolyte emit differently under the influence of the fields that are present. The phenomena that occur in the oxidation of the so-called "valve metals" are also explained. H. L. B.

1277. Effect of Water in Rectifying Contacts. R. Audubert and J. Roulleau. *Comptes Rendus,* 198. *pp.* 344–346, *Jan.* 22, 1934.—In the case of rectifying contacts formed by a layer of a powdered metallic salt (PbO_2, CuI, Fe_2O_3 + CuI, Ag_2S, MnO_2, PbS) compressed between a carbon electrode and a silicon electrode oxidised superficially, current passes more easily when the silicon is positive, at small applied voltages, but at higher voltages the reverse is true. The inversion occurs at a voltage between 0·5 and 2 volts. It is shown from determinations of the current-voltage characteristics of the contact Si/SiO_2/PbO_2/C after successive periods of desiccation in vacuum at 100°, that the inversion point moves to higher voltages (to 12 volts after 24 hours drying). At the same time, the resistance of the contact increases. Explanations of these effects due to traces of water, in terms of electrolytic and electronic processes occurring at the various surfaces of separation, are proposed. W. S. S.

1278. Action of Separating Layer in Rectification at Imperfect Contacts. Quintin. *Comptes Rendus*, 198. *pp*. 347–349, *Jan*. 22, 1934.—Experiments are described which show that rectification effects can easily be obtained when two conductors of different material are separated by a layer of thickness considerably greater than 10^{-5} cm. The tests were carried out with Si and either Cu, C, Sn or Cd. With Cu and C the current passes more easily when the Si is positive, but the reverse is the case for Sn and Cd used with silicon. This shows that the sense of the passage of current in such cases is not essentially connected with the difference of electrical conductivity of the two electrodes, since Si is the worst conductor of all the electrode substances used. A. W.

1279. Rectifying Action of Lead Sulphide. F. Heineck. *Phys. Zeits*. 35. *pp*. 113–118, *Feb*. 1, 1934.—The effects of various gases and vapours on the rectifying properties of twice-sublimed lead sulphide were studied. H_2, O_2, N_2 and CO_2 induced a weak rectifying action which disappeared in a vacuum of 10^{-2} mm. Hg. H_2S had no effect. The vapours of water, benzol, acetone and methanol produced a strong effect, which persisted slightly in vacuum in all cases except water. It appears therefore that the rectifying action is due to the formation of an adsorbed layer whose chemical constitution may not be important; it is possible, however, that chemical action may have the same effect. No connection was found between the rectifying action and contact potential. D. H. F.

1280. Current Stability in a Supraconductor. L. Brillouin. *J. de Physique et le Radium*, 4. *pp*. 677–690, *Dec*., 1933.—A discussion of various difficulties encountered in the interpretation of supraconductivity and in particular of an objection raised by F. Bloch to a preceding paper [see Abstract 4627 (1933)]. The perturbations due to irregularities of structure of the network and to its thermal agitation are considered in detail with special reference to metals with a structure of the cubic face-centred and body-centred type. An article of Frenkel's [see Abstract 3764 (1933)] on the possible explanation of supraconductivity by taking account of the inductive forces which electrons exert on each other when they move in an organised way is criticised, and the part played by the inductive forces is indicated. The conditions necessary for the passage from the resistant to the supraconducting state are discussed. R. L.

1281. Measurements with the Aid of Liquid Helium. Part XXIII. Supraconductivity of Vanadium. W. Meissner and H. Westerhoff. *Zeits. f. Physik*, 87. 3–4. *pp*. 206–209, *Dec*. 23, 1933.—The supraconductivity of three samples of vanadium has been investigated. X-ray analyses reveal the presence of iron, zinc, and platinum in various amounts. The supraconductivity measurements appear to reveal impurities undetected by the X-ray methods, and the presence of vanadium nitride in one sample is suggested to account for the difference in the supraconductivity of it and of the other two. [See Abstracts 1997 (1931) and 4626 (1933)]. W. R. A.

1282. Electronic Conduction in Halogen Salts of the Alkali Metals. R. Hilsch and R. W. Pohl. *Zeits. f. Physik,* 87. 1–2. *pp.* 78–88, *Dec.* 13, 1933.—When photoelectrons or thermions leave a surface residual positive charges remain. These must be compensated by means of currents. The authors give examples to show how this compensation is effected partly by electrons that replace those which have left and partly by ions of the dark current. The crystals used are NaCl, KCl, KBr. H. L. B.

1283. Electronic Conduction in Crystals. R. W. Pohl. *Phys. Zeits,* 35. *pp.* 107–111, *Feb.* 1, 1934.—An optical means of investigating the process of electronic conduction is obtained by using transparent crystals of NaCl or KBr. In the neighbourhood of a pointed kathode a coloured electron cloud is produced which spreads out from the point and rapidly fills the crystal. The coloration is due to an absorption spectrum, and varies with the nature of the crystal and with temperature, the width of the absorption band increasing with increase in temperature. It is possible to calculate the number of electrons causing the absorption, and their velocity has been measured in a crystal of KCl, over a temperature range 500 to 750° C. The curves showing the variation of velocity and of conductivity with temperature are similar in form. The electrons can also be freed by the action of light and it would seem that the production of a latent photographic image may be closely connected with the process of electronic conduction. R. W. P.

1284. Electrical Resistance of Peranthracites. P. Lebeau and P. Corriez. *Comptes Rendus,* 198. *pp.* 170–172, *Jan.* 8, 1934.—The electrical resistance of a number of anthracites has been measured, and is shown to increase with the volume of gas disengaged at 1000° C. The amounts of ash show no such relation, but the H content is parallel with resistance. A. S. C. L.

1285. Electric Conductivity of Powdered Graphite under Pressure. J. Brunner and H. Hammerschmid. *Zeits. f. Elektrochem,* 40. *pp.* 60–67, *Feb.,* 1934.—Six different kinds of graphite are subjected to Ryschkewitsch's method of determining electric conductivity under pressures from 31 to 300 atmospheres, and give results which show that the resistance varies inversely as the square root of the pressure, in agreement with Holm's theory. Twenty different kinds of graphite are then subjected to a simplified method in order to find the dependence of the change of conductivity on space density and compressibility. H. M. B.

1286. Non-Conducting Modifications of Metals. J. Kramer. *Ann. d. Physik,* 19. 1. *pp.* 37–64, *Jan.,* 1934.—It is shown that both by kathode-sputtering and by vaporisation films of metals, about 10^{-4} cm. thick, can be produced which possess a conductivity of about one-millionth of that of the normal metal. Fe, Ni, Pt, Zn, Sn, Cd and Sb have been obtained in this anomalous form, but not Ag, Cu and Bi. Each of these anomalous metals possesses a " transformation " temperature at which the conductivity suddenly increases, and an empirical relation has been found between this temperature and the conductivity of the normal metal. It is considered that in the anomalous modification the metal is in the amorphous form, but that at the " transformation " temperature the metallic lattice is formed and the conducting electrons are freed. This view receives support from the fact that the resistance of the anomalous metal decreases with increase in temperature and under the influence of light. The effect of a transverse magnetic field is also studied. R. W. P.

1287. Electrical Conductivity and Phase Diagram of Binary Alloys. System Magnesium-Thallium. G. Grube and J. Hille. *Zeits. f. Elektrochem.* 40. *pp.* 101–106, *Feb.*, 1934.—The electrical resistance of a number of alloys of Mg and Tl ranging from pure Mg to pure Tl is determined at temperatures up to incipient melting. From the form of the curves showing specific conductivity as a function of concentration and of temperature conclusions are drawn as to the phase boundaries of the system. These are confirmed by investigation of the thermal expansion of the alloys. Since the results are at variance in some points (existence of Tl_2Mg_5 instead of Tl_3Mg_8) with earlier determinations of the phase diagram, and since further Zintl and Brauer [see Abstract 2133 (1933)] have recently demonstrated by the X-ray method the existence of the compound TlMg, the alloys in the concentration range 20 to 60 atomic % of Tl are reinvestigated by the thermal method. Confirmation of the existence of TlMg is obtained in that a flat maximum is observed near 50 % Tl and a eutectic point at 42·5 % Tl and 353° C. A complete phase diagram is constructed for the system on the basis of the results obtained. L. A. W.

1288. Resistance of Cu-Pd Alloys. D. Stockdale. *Faraday Soc., Trans.* 30. *pp.* 310–314, *Feb.*, 1934.—The resistance of a range of six alloys containing 53·44 to 60·77 atomic % of Pd was measured. The temperature coefficients were also determined; they were found to be small and to decrease with rise of temperature. F. J. B.

1289. Conductivity of Insulating or Feebly Conducting Liquids in Thin Layers. Thérèse Meyer. *Comptes Rendus*, 198. *pp.* 160–163, *Jan.* 8, 1934.—The electrodes employed were of stainless steel, 1 cm. diameter, and worked optically flat and were separated by distance pieces of quartz or mica before immersion in the liquid under test. The electrode distance was usually 20 microns and with a voltage of from 0 to 750 volts suitable deflections could be obtained with a series resistance of 5×10^4 ohms and a galvanometer giving a deflection of 1 mm. for a current of 10^{-7} A. A table is given of the specific conductivities of 18 organic liquids, all of which were ordinary commercial products. It was found, however, that careful purification of some of the liquids produced no great change of conductivity. In general, the resistivity was found to decrease as the current through the test liquid increased and it also varied with the thickness of the liquid film. The variation of conductivity with temperature was very small for all the liquids tested and was comparable with the corresponding variation of viscosity. The results are briefly discussed. A. W.

1290. Conductivity in the Transition Region from Strong to Weak Electrolytes. R. M. Fuoss. *Phys. Zeits.* 35. *pp.* 59–68, *Jan.* 15, 1934.—A theoretical expression is derived for the conductivity of an electrolyte. It is sho[illegible] that the strength of the electrolyte is defined by a parameter equal to the ratio of the potential energy of two ions at the moment of contact to the energy dissipated by the heat motion. When this ratio is small, as when the dielectric constant of the solvent or the mean ionic diameter of the electrolyte is large a strong electrolyte results, but when the ratio is large the electolyte is weak. R. W. P.

1291. Conductivities of $TiCl_4$, $SnCl_4$ and $SiCl_4$ in Non-Aqueous Solutions. E. Wertyporoch and B. Altmann. *Zeits. f. phys. Chem.* 168. *Abt.A.* 1. *pp.* 1–30, *Feb.*, 1934.—The electrical conductivities of $TiCl_4$, $SnCl_4$ and $SiCl_4$ have been measured when dissolved in the following liquids, methanol, ethyl alcohol, allyl alcohol, benzyl alcohol, benzaldehyde,

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cinnamic aldehyde, acetone, acetophenone, acetonitrile, benzonitrile, ethyl ether, dioxane, *n*-propyl-chloride, isopropyl-chloride, benzal chloride, benzyl chloride, ethyl bromide and allyl chloride. The results are tabulated, and curves showing the variations of specific conductivity and of molar conductivity with the concentration of each tetrachloride are included. R. W. P.

1292. Conductivity of Aluminium Bromide in Non-Aqueous Solutions. E. Wertyporoch and B. Adamus. *Zeits. f. phys. Chem.* 168. *Abt.A.* 1. *pp.* 31–44, *Feb.*, 1934.—Measurements have been made of the electrical conductivity of $AlBr_3$ when dissolved in various proportions in the following liquids: acetonitrile, benzonitrile, nitrobenzene, *p*-nitro-toluene, *m*-nitro-toluene, *o*-nitro-toluene, *m*-chlorotoluene, *o*-chlorotoluene, *p*-chlorotoluene, *o*-dichlorbenzene, iodobenzene, fluorobenzene, *m*-bromotoluene *o*-bromotoluene and *p*-bromotoluene. Tables and figures are included giving the specific and molar conductivities at various concentrations. R. W. P.

1293. Conductivity in a Dielectric in which Both Kinds of Ions Are Mobile. J. J. Sämmer. *Phys. Zeits.* 35. *pp.* 29–33, *Jan.* 1, 1934.—A mathematical paper in which an approximate formula is given, and is studied for the variation of current with time at constant voltage. Formulæ are worked out which give the ionic mobility from a given current distribution. Some examples are solved by graphical methods. R. L.

See also Abstracts 933, 1213, 1300, 1301, 1302, 1335.

DIELECTRICS AND CAPACITANCE.

1294. Polar Properties of Certain Hydrogenated Napthalenes. M. Puchalik. *Acta Physica Polonica*, 2. 3. *pp.* 305–310, 1933. *In German.* —The present investigation continues previous work on the relationship between molecular structure and polarity of napthalene derivatives [see Abstract 3374 (1932)], and deals with the polar properties of tetrahydronaphthalene and of *cis*-decahydronapthalene. The tetralin molecule is found to be a dipole ($\mu = 1 \cdot 66 \times 10^{-18}$ e.s.u.) in agreement with its asymmetrical formula; the polarisation curve for tetralin-benzene solutions exhibits a similarity to the curve for nitrobenzene-benzene solutions. *Cis-* and *Trans*-Decalin do not form dipole molecules, a fact in agreement with previous studies of ordinary decalin. H. H. Ho.

1295. Dielectric Coffiecients of Gases. Part II. H. E. Watson, G. G. Rao and K. L. Ramaswamy. *Roy. Soc., Proc.* 143. *pp.* 558–588, *Feb.* 1, 1934.—The dielectric coefficients of 17 gases were measured at two and for some at three temperatures and their electric moments deduced from the results. Compressibilities were directly determined by making measurements at different pressures. The dielectric coefficient of helium was redetermined in order that the result might be used for measuring the deformation of a condenser with pressure. The construction and calibration of a precision variable condenser capable of measuring a change in capacity of 0·4 $\mu\mu$F. with an accuracy of 0·0001 $\mu\mu$F. is described. The results are compared with those of previous observers, satisfactory agreement being obtained in certain cases. Of the gases investigated only propylene, carbon monoxide, nitrous oxide, and nitric oxide have measurable electric moments. The existence of such a moment for nitrous oxide is considered in relation to the structure of the molecule, and the possibility of a slightly bent symmetrical molecule discussed. A tentative explanation for the small moment of the unsymmetrical linear form is put forward which would enable this type of molecule to be accepted as most probable in conformity with the results obtained by other methods. [For Part I see Abstract 181 (1932).] AUTHORS.

1296. Dipole Measurements with Very Small Quantities of Material. P. C. Henriquez. *Physica,* 1. *pp.* 41–52, *Dec.,* 1933.—By considering the principles involved in the calculation of dipole moments formulæ are derived which simplify the calculations. It is shown that the capacity of the liquid condenser must be at least $10\mu\mu$F, and the construction of a condenser having this capacity and requiring only a few mg. of substance is described. Results for naphthodioxan are given. Measurements of temperature coefficients cannot be made with sufficient accuracy to be of any theoretical value. W. R. A.

1297. Dipole Moments of Associated Molecules and Validity of Mass Action Law During the Association. I. Sakurada. *Zeits. f. phys. Chem.* 24. *Abt.B.* 5–6. *pp.* 437–444, *Feb.,* 1934.—Based on the assumption that by association a well defined stoichiometric complex of two or three molecules arises, and that during such association the mass action law is valid, there has been derived a simple relationship between the orientation-polarisation of simple or associated molecules and the concentration of the solution whereby the equilibrium constant may be calculated. This relationship has been applied to the experimental data given by Rolinski, Williams and Lange for chlorobenzene, chloroform, ethyl- and methyl-acetate and nitrobenzene dissolved in non-polar solvents, whereby it is found to hold good in most cases from dilute to highly concentrated solutions. Chlorobenzene, ethyl- and methyl-acetate, and chloroform, form almost always a double complex which is non-polar, whilst a non-polar triple complex always occurs in the association of nitrobenzene. Chloroform in benzene appears to associate to a polar double complex. H. H. Ho.

1298. Dielectric Constants. Part III. Aqueous Gelatin Solutions. A. L. Ferguson, J. G. Malone and L. O. Case. *J. Chem. Phys.* 2. *pp.* 94–98, *Feb.,* 1934.—Measurements have been made of the dielectric constant of gelatin solutions. A test of the Bjerrum *Zwitter-ionen* theory was furnished by a study of the effect of pH on the dielectric constant as measured by the Drude method; the data obtained support the theory. Through the application of an equation suggested by Marinesco, an attempt was made to determine the amount of water fixed by gelatin; if this equation is valid for gelatin the results obtained for absorbed water must be interpreted as indicating that the water bound by the gelatin is still free to show its dielectric properties. By means of another equation given by Marinesco relating dielectric absorption with molecular weight, values were calculated for the molecular weight of gelatin; the results obtained are consistent with those given by other methods. [See Abstract 332 (1934) and following Abstract]. AUTHORS.

1299. Dielectric Constants. Part IV. Moments of Some Inorganic Compounds. Mary G. Malone and A. L. Ferguson. *J. Chem. Phys.* 2. *pp.* 99–104, *Feb.,* 1934.—The moments of some inorganic compounds have been determined, some in more than one solvent, and the best values are believed to be: for $SbCl_3$, 3.12; $SbBr_3$, 2.47; SbI_3, 1.58; AsI_3, 0.96; $AsBr_3$, 1·60; PI_3, 0.0; AsF_3, 2.65; and $LiClO_4$, 7.84 Debye. The dielectric constant of solid AsF_3 was measured and found to be 5.7. The moments of the molecules measured have been calculated from the

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electronegativity of the elements and compared with the measured values. A fair agreement is found with deviations greatest for molecules of highest polarisability and possessing large moments. The electronegativity values were deduced from the measurements of the hydrogen compounds or from their periodic relationship. [See preceding Abstract.] AUTHORS.

1300. Shot Effect and Electrical Breakdown in Insulators. F. E. Haworth and R. M. Bozorth. *Physics,* 5. *pp.* 15–19, *Jan.,* 1934.—Measurements are made of the fluctuations in currents passing through insulating materials subjected to high, constant electric fields. Applying the theory of the shot effect to these fluctuations, the average number of elementary charges (electrons or ions) which discharge on to the electrodes as a unit is calculated. In glass, this number increases exponentially with the field from about one at low fields to about 10^6 at fields just below breakdown. Considered with respect to various theories offered in explanation of electrical breakdown, the results indicate that the shot effect is caused by " avalanches " of electrons discharging through paths in the material over which breakdown occurs at higher fields, the avalanches increasing in size with the field until the material is ruptured. By making use of the Johnson effect (thermal agitation of electricity) a new and simple method has been worked out for calibrating the amplifier for shot effect measurements. AUTHORS.

1301. Abnormal Absorption and Heating in H.F. Condensers. H. Haase. *Phys. Zeits.* 35. *pp.* 68–76, *Jan.* 15, 1934.—A method is described by which the abnormal dispersion in dipolar liquids can be measured in terms of the heating produced in them when used as the electrolyte of a h.f. condenser. Hexyl alcohol diluted with different amounts of benzene, and amyl alcohol diluted with benzene and xylene were tested. It was found that as the degree of dilution increased (1) the magnitude of the absorption decreased; (2) the maximum absorption occurred at higher frequencies; (3) the width of the resonance band became greater. The results agree with Debye's theory as regards sign and order of magnitude, but differ from it in that for the pure alcohols the wave-length corresponding to the maximum absorption was about double the theoretical value, and also the displacement of the maximum due to change in the viscosity was smaller than anticipated. R. W. P.

1302. Absolute Measurement of the H.F. Absorption of Electrolytes in Glycerin and Mixtures of Glycerin and Water. J. Hiegemann. *Phys. Zeits.* 35. *pp.* 91–93, *Jan.* 15, 1934.—Whitmore has shown [see Abstract 5027 (1933)] that at wave-length $\lambda = 0 \cdot 75$ m. the absorption of solutions of electrolytes (KCl; $Ca_2Fe(CN)_6$) in glycerin is smaller than that of pure glycerin. In the present paper measurements are described at 25° C. with the electrolyte thermometer using Malsch's method [see Abstract 2998 (1932)]. The method is equally good for both h.f. and l.f. and can be used as an absolute method for determining directly the absorption in KCl solutions. The relation $x = Cl/\lambda^2$ is obeyed with great accuracy for glycerin. Tables are given of the increase of conductivity at wave-lengths 23 m., 46 m. and 92 m. for $MgSO_4$ and also for KCl in glycerin and mixtures of water and glycerin. The results are discussed briefly. R. L.

1303. H.F. Loss and Molecular Structure. P. Debye. *Phys. Zeits.* 35. *pp.* 101–105, *Feb.* 1, 1934.—A discussion of dispersion in liquids in the region of short electric waves. A method for measuring the loss by the heating of the dielectric is described. Non-polar molecules (benzene,

CCl_4, decalin, hexane, cyclohexane and CS_2) gave no loss, while polar molecules (dichlorbenzenes) showed an effect increasing with the dipole moment. The absolute value of the relaxation time, its connection with the viscosity of the solvent, and calculation of the loss in a mixture are discussed. W. R. A.

1304. Indication of Small Changes of Capacity by Means of a Bridge Arrangement. H. F. Nissen. *A.T.M.* 3. *T2. Jan.* 31, 1934. —It is shown that the principle of the a.c. bridge is specially suitable for the measurement of small capacities and changes of capacity, since it renders possible the employment of relatively low frequencies and thus avoids sources of error in the high-frequency method. It affords an arrangement simple in structure and of very high sensitiveness. Details of the practical arrangement with diagrams are given. J. J. S.

1305. Dielectric Properties of Rochelle Salt. H. Staub. *Helv. Phys. Acta,* 7. 1. *pp.* 3–45, 1934. *In German.*—The changes in intensity of the X-ray reflection from the (222) plane, due to the presence of an electric field are measured in the case of Rochelle salt, and the connection between crystal structure and dielectric properties is fully discussed. The lattice constants of Rochelle salt are determined. The size of the rhombohedral unit cell is found to be: $a = 11\cdot91 \pm 0\cdot04$ Å, $b = 14\cdot32 \pm 0\cdot05$ Å, $c = 6\cdot20 \pm 0\cdot02$ Å. The number of molecules per unit cell is four. J. T.

See also Abstracts 875, 1058, 1306.

ELECTROCHEMISTRY.

1306. Theory of Concentrated Solutions of Strong Electrolytes. G. B. Bonino, G. Centola and M. Rolla. *Accad. d'Italia, Mem.* 4. 13. *pp.* 415–444; 4. 14. *pp.* 445–464, *and* 4. 15. *pp.* 465–479, 1933.— In the first part of this series of papers a summary is given of some theoretical views relative to the thermodynamics of solutions of electrolytes. The general foundations of the theory of Debye-Hückel are developed and some difficulty which may occur in the application of that theory is pointed out. With the application of a particular criterion of convergence the endeavour is made to arrive at a relation capable of expressing the coefficients of activity of the ions of strong electrolytes in concentrated solutions on a basis of the knowledge of the fundamental physical constants of the ions and the solvents. In the second part the fundamental relations which have been deduced are applied to the calculation of the constants referred to, and in the third part they are employed for the calculation of the lowering of the vapour tension of the solvent in concentrated and very concentrated aqueous solutions of strong electrolytes. The values thus calculated are compared with those obtained from the results of experiment. J. J. S.

1307. Statistical Basis of the Theory of Electrolytes. O. Halpern. *J. Chem. Phys.* 2. *pp.* 85–93, *Feb.,* 1934.—In the following paper the author investigates how far the various statistical-thermodynamic methods hitherto proposed are suitable for application to strong electrolytes. The significance of the ionic radius is, in many instances, far more important than has hitherto been assumed. When the influence of the ionic radius is negligible conditons are derived from dimensional considerations which considerably restrict the functional form of the free energy. Furthermore, proceeding from conditions of integrability; thermodynamics appreciably limits the number of possible expressions for the ionic potential. The disregarding of these limitations has been responsible for certain paradoxes in the literature on this subject. A new fluctuation formula for the electric potential of the ions is derived and conclusions are drawn from it as to the correctness of existing theories. In connection with this last a deduction proposed by Fowler is reviewed. Kramers' theory of electrolytes is tested with respect to its agreement with the theorems here developed. Finally, a review of the statistical and thermodynamical basis of Bjerrum's theory of ionic association is presented. AUTHOR.

1308. Optical Method of Investigating Concentration Polarisation. A. G. Samarcev. *Zeits. f. phys. Chem.* 168. *Abt.A.* 1. *pp.* 45–58, *Feb.*, 1934.—A description is given of an optical method, depending on the use of a Lebedev polarisation interferometer, for determining concentration polarisation during electrolysis. The distribution of concentration in the diffusion layer, and the thickness of the layer, are measured under various experimental conditions, and the equation relating current density with concentration gradient at the electrodes is confirmed. Diffusion coefficients are calculated for the electrolytes used, and it is observed that in the cells Cu | $CuSO_4 \cdot aq$ | Cu and Ag | $AgNO_3 \cdot aq$ | Ag the total polarisation is greater than the concentration polarisation. C. B. A.

1309. Structure of Electrolytic Deposits of Copper Formed in Presence of Colloids. P. Jacquet. *Comptes Rendus*, 198. *pp.* 74–76, *Jan.* 3, 1934.—Sections of the deposits obtained by electrolysing for five hours at 18–20° with a current density of $2A/dm.^2$ a solution containing 125 gm. $CuSO_4$ and 25 gm. H_2SO_4 per l, to which varying amounts of (*a*) gelatin, (*b*) serum-albumen, (*c*) gum arabic, (*d*) gum tragacanth, (*e*) dextrin, or (*f*) glycine had been added, were examined microscopically ($\times\ 500 - 1000$). (*a*) and (*b*) are the most active, diminishing the size of the crystals of copper until with $>$ 1 gm./l. of (*b*) all crystalline appearance vanished; (*c*) and (*d*) are less active, but cause some reduction in size of crystals, more than 2 gm./l. of (*d*) giving a pulverulent deposit; (*e*) and (*f*) have little effect. The order of activity is that of adsorbability. [See Abstract 743 (1933).] C. A. S.

1310. Electrode Potentials in Solutions of Foreign Electrolytes. O. Essin and M. Lozmanowa. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 209–220, *Dec.*, 1933.—The potential of gold electrodes in solutions of copper sulphate and nitrate and silver nitrate has been determined. In all cases it bears a linear relationship to the potential of copper or silver in similar solutions, *i.e.*, $E_{Au/MeX} = a + b\,E_{Me/MeX}$; a and b depend on the nature of the kation (Me) and to a less extent on that of the anion (X). Further $E_{Au/MeX} = E_{oAu/MeX} + b(RT/nF) \log f_{Me}, c_{Me}$. These results cannot be fully interpreted in terms of the classical electrochemical theory; it is probable that adsorption phenomena play a part, in that the kations are adsorbed from the electrolyte upon the gold and form the positive part of an electrical double layer, the negative part being formed from the excess of anions in the solution. H. F. G.

1311. Swelling of Graphite at the Anode, and Mechanical Destruction of Carbon Anodes. H. Thiele. *Zeits. f. Elektrochem.* 40. *pp.* 26–33, *Jan.*, 1934.—The mechanical destruction of carbon anodes during electrolysis was studied and is shown to be due mainly to the swelling of the graphite anode. The conditions necessary for the swelling to take place are: discharge of oxygen at a potential of 1·6 V, and the presence of ions of sulphates, perchlorates, nitrates, and fluorides, sufficient current density, and presence of water. The swollen graphite contains more oxygen than the primary oxide of carbon. Graphite swells readily and is oxidised with difficulty. Amorphous carbon swells with difficulty, but is easily oxidised. F. J. B.

1312. Electrolytic Oxidation. S. Glasstone and A. Hickling. *Chem. Soc., J. pp.* 10–18, *Jan.*, 1934.—The potential variation of a Pt anode in the electrolysis of a chloride solution at constant current density was studied under a variety of conditions. Two stages were observed, the one corresponding to the reversible Cl ion discharge potential, the other about 0·6 volt higher. The results are discussed in the light of the theory that there is, in addition to the reversible discharge of halogen ions at the anode, the irreversible formation of H_2O_2 resulting from the combination of the discharged OH ions. F. J. B.

1313. Magnesium Electrode in Ether Solution and the Free Energy of Formation of Magnesium Bromide. G. A. Scherer and R. F. Newton. *Am. Chem. Soc., J.* 56. *pp.* 18–20, *Jan.*, 1934.—Experimental data are given for the e.m.f. of the cell Mg, saturated ether solution of $MgBr_2 2(C_2H_5)_2O$, Hg_2Br_2, Hg at 25°, and the vapour pressure at 25° of the di-and and mono-etherate of magnesium bromide. The calculated free energy of formation at 25° of magnesium bromide is $-114,000$ cal. N. M. B.

1314. Influence of Kathodic Hydrogen upon the Mechanical Strength of Steel. D. Alexejew, P. Afanassjew and W. Ostroumow. *Zeits. f. Elektrochem.* 40. *pp.* 92–98, *Feb.*, 1934.—Measurements are carried out upon the effect of additions of H_2S, SO_2 and As_2O_3 on the lowering of the mechanical strength of steel wire kathodes by absorption of hydrogen in the electrolysis of sulphuric acid [see Abstract 3194 (1933)]. The following factors are investigated: current density, mechanical load on the wire, concentration of added substance, time and temperature. Neither metallographic nor X-ray examination of the wires shows any change of structure due to the hydrogen taken up. It is considered that the hydrogen is present in the steel in two conditions, one loosely bound and capable of removal by mild mechanical or heat treatment, and the other probably in solid solution. No reduction of mechanical strength occurs with pure acid or with tempered wire. The influence of added substances is explained as due to the intermediate formation of hydrides which act as hydrogen carriers. L. A. W.

1315. Heat of Ionisation of Certain Metals. W. A. Roth and A. Büchner. *Zeits. f. Elektrochem.* 40. *pp.* 87–89, *Feb.*, 1934.—The heats of solution of the anyhdrous chlorides of Al, Ga, In, Zn, and Cu were determined. From the results of the determinations, the heats of ionisation were calculated. The heats of ionisation of beryllium, and of iron to the ferric ion were calculated from other measurements. F. J. B.

1316. Cryoscopic Determination of Hydration of Ions of Calcium Chloride. F. Bourion and E. Rouyer. *Comptes Rendus*, 198. *pp.* 175–176, *Jan.* 8, 1934.—The hydration of the ions in $M/2$ and $M/4$-$CaCl_2$ is represented respectively by $CaCl_2,27H_2O$ and $CaCl_2,30\cdot6H_2O$. [See Abstract 4249 (1933).] C. A. S.

See also Abstracts 872, 885, 902, 974, 1290, 1366

ELECTRONS, POSITRONS AND PROTONS.

1317. Materialisation of Ether. V. Posejpal and A. Cotton. *Comptes Rendus*, 198. *pp.* 59–62, *Jan.* 3, 1934.—Reference is made to the hypothesis put forward in a previous paper [see Abstract 5055 (1932)], according to which the ether is composed of atoms the nuclei of which have been formed by the combination of a proton and an electron with the evolution of two photons. Such atoms would have no rest mass and zero atomic number. The converse process, which results in the formation of protons and electrons is also pictured as occurring. An experiment is described in which the possibility of this latter process was investigated. A cylindrical electrode which surrounds an axially placed palladium wire is contained in an evacuated vessel and a high potential is applied between them. When the filament is the kathode it is found that the application of the electric field causes an increase in its resistance owing to its absorbing hydrogen. The author concludes that this hydrogen was actually formed within the vessel by the process of materialisation suggested. The possibility of its having arisen from traces of water vapour is discussed.

J. E. R. C.

1318. Annihilation of Positrons. F. Joliot. *Comptes Rendus*, 197. *pp*. 1622–1625, *Dec*. 18, 1933.—An experiment designed to test Dirac's theory that a positron, on meeting a free electron, combines with it to form two photons each having energy 5×10^5 electron volts emitted in opposite directions, is described. An intense source of positrons was placed in an inhomogeneous magnetic field which focussed them on a target of lead or aluminium placed above a Geiger counter. By interposing an absorption of 1·5 mm. of lead in the path of the positrons the counter registered an increase of 16 %. The radiation to which this was due was found to obey an exponential absorption law giving μ/ρ for lead as 0·24, corresponding to photons of energy $4 \cdot 85 \pm 0 \cdot 6 \times 10^5$ electron volts. The number of quanta emitted by the target in a solid angle of 2π was of the same order as the number of positrons striking it. If photons of any other energy were emitted by the lead under positron bombardment, they were not sufficiently numerous to be detected. The author concludes that the experiments confirm Dirac's hypothesis. J. E. R. C.

1319. Annihilation of Positrons. F. Joliot. *Comptes Rendus*, 198. *pp*. 81–83, *Jan*. 3, 1934.—According to Dirac's theory a positron may be annihilated either by meeting a free electron, when two photons of energy 5×10^5 electron volts are produced, or by encounter with an electron bound to a nucleus, in which case a single photon of energy 10^6 electron volts is formed. A third possibility is the production of one photon of energy 5×10^5 electron volts and a neutron. The author has made a determination of the number of photons corresponding to the annihilation of a single positron. This number lies between 1·6 and 3, having a probable value of 2. The absorption coefficient of the photons corresponded to an energy of approximately 5×10^5 electron volts and it is concluded that annihilation is principally due to encounters between positrons and free electrons. [See preceding Abstract.] J. E. R. C.

1320. Annihilation of Positrons. J. Thibaud. *Comptes Rendus*, 197. *pp*. 1629–1632, *Dec*. 18, 1933.—It is generally supposed that positrons in their passage through matter can combine with electrons with the evolution of radiation of 5×10^5 electron volts energy. The author describes experiments designed to detect this radiation. A difficulty arises owing to the radiation excited by inelastic collisions of the positrons with atoms but the experimental method overcomes this. Positrons or electrons can, at will, be focussed on a photographic plate, and their absorption curves are plotted from measurements of the density of blackening produced. In each case the absorption curves consist of two parts, the first corresponding to the absorption of the particles and the second to the absorption of the radiation they produce. It is shown that positrons produce a much larger amount of radiation than do electrons and that the hardness corresponds to 5×10^5 electron volts, *i.e.*, the energy of the radiation expected to result from the coalescence of a positron and an electron. J. E. R. C.

1321. Positron Tracks. D. Skobelzyn. *Nature*, 133. *pp*. 23–24, *Jan*. 6, 1934.—In view of the hypothesis (put forward by Oppenheimer and Plesset) that γ-radiation can, by absorption, form a positive and a negative electron, the author has re-examined some of his Wilson chamber photographs. Several photographs, which appear to show a positive and a negative electron originating from the same point, are discussed. It is shown that their energies are consistent with this assumption and that the process is more frequent than was predicted by Furry and Carlson. A photograph showing a new effect, *viz*., the production of a positive and a negative electron by a β-ray, is also reproduced and discussed. J. E. R. C.

1322. Value of e/m from the Zeeman Effect. L. E. Kinsler and W. V. Houston. *Phys. Rev*. 45. *pp*. 104–108, *Jan*. 15. 1934.—The measurement of e/m from the Zeeman effect of the red singlet lines of Cd and Zn has been repeated with careful attention to all of the sources of experimental uncertainty. The magnetic field has been measured, under the actual conditions of operation, with an uncertainty of about one part in three thousand. The final result is $e/m = 1 \cdot 7570 \pm 0 \cdot 0010$ e.m.u. AUTHORS.

1323. Determination of Inner Potential by Means of Electron Diffraction. W. E. Laschkarew. *Zeits. f. Physik*, 86. 11–12. *pp*. 797–801, *Dec*. 7, 1933.—It is widely believed that deviations from Bragg's relationship concerning electron diffraction makes it possible to determine the inner potential of a metal. Experimental results do not confirm this view sufficiently [see Abstract 3208 (1933)]. The author enquires into what physical quantity is actually being determined when these deviations are investigated. Taking into account the periodic field in the interior of a crystal he derives a modified Bragg formula for electron diffraction. The field is assumed to be a function of only one coordinate, the depth. The deviations from Bragg's formula are found to depend not only on the mean value of the potential inside the crystal, but also on the manner in which the potential changes. H. L. B.

1324. Stationary Treatment of the Elastic Scattering of very Fast Electrons. F. Sauter. *Zeits. f. Physik*, 86. 11–12. *pp*. 818–820, *Dec*. 7, 1933.—Born's method of treating the elastic scattering of electrons in static fields of force according to non-relativistic wave-mechanics is worked out on the basis of relativistic wave-mechanics. It is found that, to a first approximation, the electron spin exerts no influence on the scattering. H. L. B.

1325. Determination of the Size of Particles by Means of Electron Beams. R. Brill. *Zeits. f. Krist*. 87. *pp*. 275–280, *Feb*., 1934.—A relation is derived connecting the width of electron diffraction rings with the size and shape of the diffracting crystalline particles. This relation agrees with that given by Scherrer for X-rays in the case of cubical crystals if one assumes that the interference function derived by Laue for X-rays is also applicable to the case of fast electrons. J. E. K.

1326. Investigation of Thin Films of Organic Substances by Electron Diffraction. C. A. Murison. *Phil. Mag*. 17. *pp*. 201–225, *Feb*., 1934.—The method of electron diffraction was used to investigate a type of pattern obtained with films of certain "grease-like" mixtures spread on various types of backing. This pattern indicates orientation of the molecules normal to the surface of the film, and experiment shows that this orientation is present both at the vacuum-grease and "backing-grease" interfaces. A substance which gives this pattern is likely to act well as a lubricant. AUTHOR.

1327. Electron Diffraction Experiments with Graphite and Carbon Surfaces. R. O. Jenkins. *Phil. Mag.*, 17. *pp.* 457–466, *Feb.*, 1934. *Supplement.*—Natural graphite has an inner potential of 10·7 volts. This value, assuming the X-ray value for the (002) spacing, becomes 11·0 volts. Any attempt to polish a graphite surface causes the crystals to take up an orientated position with the main cleavage plane (001) in the plane of the specimen, as well as reducing the crystal size. In the case of carbon the polishing breaks up the aggregates of very small graphite crystals comprising the grains of carbon, and only after the surface is largely composed of these small crystals broken off from the aggregates does the usual orientation appear. As those crystals are already so small very little reduction in size takes place during polishing. Finally, the existence of absorbed graphite films on metal has been proved, and that friction reduces crystal size and causes orientation of the graphite crystals in this layer has also been shown. AUTHOR.

1328. Structure of Oxide Films on Nickel. G. D. Preston. *Phil. Mag.* 17. *pp.* 466–470, *Feb.*, 1934. *Supplement.*—Films of nickel oxide prepared on the surface of a nickel sheet so as to produce a number of parallel interference bands have been examined by the electron-diffraction method. The crystal structure of the film is found to be identical, within the limits of error of observation, with massive NiO having a rock-salt type of lattice of approximately 4·10 Å parameter. AUTHOR

1329. Crystal Structure and Orientation in Zinc-Oxide Films. G. I. Finch and A. G. Quarrell. *Phys. Soc., Proc.* 46. *pp.* 148–162; *Disc.*, 162, *March* 1, 1934.—A new type of electron-diffraction camera is described incorporating means for greatly increasing the accuracy hitherto obtainable in electron-diffraction analysis. Partially and completely oxidised zinc films have been examined by transmission. It has been found that the normal type of zinc oxide is formed by the oxidation of zinc *via* a zinc oxide which is basally pseudomorphic with the zinc. The corrosion-resisting properties of zinc appear to be due in the main, to a protective coating of such pseudomorphic zinc oxide. AUTHORS.

See also Abstracts 953, 1069, 1082, 1099, 1330, 1345.

ELECTROSTATICS.

1330. Validity Limits to the Law of Electrical Tension in Metals (Second Law of Volta). O. Scarpa. *J. de Physique et le Radium*, 4. *pp.* 725–731, *Dec.*, 1933.—The author shows theoretically and experimentally that the law of electric tension in isothermal metallic circuits has limits to its validity, being incorrect if the metals contain a surplus of electrons or mobile ions. These cases arise in liquid metals and probably in solid metals at high temperatures. H. H. Ho.

1331. Tilted Electrometer. H. Carmichael. *Phys. Soc., Proc.* 46. *pp.* 169–184; *Disc.*, 185, *March* 1, 1934.—A detailed description is given of the construction and performance of a new, evacuated, critically damped, quick-reading, quartz-fibre electrometer. The sensitivity obtainable is limited only by the Brownian motion of the fibre. Photographic records are reproduced showing the response of the electrometer to suddenly applied potential-changes, and to the ionisation currents of individual α-particles. The minimum potential-change that can be measured (with the usual convention that the corresponding deflection of the system be not less than four times the root of mean square of the deflections of the Brownian motion) is of the order of 0·0001 V. when the period (undamped) is 5 seconds, and 0·0005 V. when the period is 1 second. The range range of approximately constant sensitivity is adequate for most purposes. AUTHOR.

See also Abstract 953.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1332. Hall Effect and other Physical Constants of Alloys. Part II. Tin-Bismuth Series of Alloys. W. R. Thomas and E. J. Evans. *Phil. Mag.* 17. *pp.* 65–83, *Jan.*, 1934.—The Hall coefficients of the tin-bismuth alloys, and their resistivities, temperature coefficients of resistance, thermoelectric powers and densities were measured over a wide range of composition. The most rapid variations in the physical properties of the alloys with composition occur in the region of low tin content, and the results are compared with those for the lead-bismuth series [see Abstract 4666 (1933)]. The resistivity-composition curve is in general agreement with that of Bucher, and an alloy containing about 1·7 % by weight of tin has the maximum resistivity. The Hall coefficient-composition curves for different fields show discontinuities at compositions which depend on the magnitude of the magnetic field, those observed occurring in the region 94 to 99 % bismuth. G. E. A.

1333. Occurrence of Negative Minimum in Resistance Hysteresis Curves for Nickel in Longitudinal Magnetic Fields. M. S. Alam. *Zeits. f. Physik,* 87. 3–4. *pp.* 255–257, *Dec.* 23, 1933.—Measurements were made of the resistance of nickel wires subjected to longitudinal magnetic fields. It was found that the negative minimum in the resistance hysteresis curve only occurs when the maximum field used for the cyclic process has a value of about 200 gauss. If the maximum field has a value of about 500 gauss, the negative minimum does not appear if the test-piece is not previously demagnetised. The negative minimum cannot therefore be due to incomplete demagnetisation of the test-piece before commencing the tests, as Stierstadt has concluded [see Abstract 3181 (1931)]. A. W.

MAGNETISM AND ELECTROMAGNETISM.

1334. Fluctuations of the Molecular Field and the Equation of the Magnetic State of Nickel. L. Néel. *Comptes Rendus,* 197. *pp.* 1310–1312, *Nov.* 27, 1933.—A continuation of an earlier paper [see Abstract 834 (1934)]. In the present calculation the resultant moment is quantised, and Langevin's law is applied. The results agree well with experiment. The equation of the magnetic state of nickel is completely interpreted by asuming that the number of magnetic electrons varies with the susceptibility. The importance of fluctuations in the molecular field is stressed. W. R. A.

1335. Skin Effect in Ferromagnetic Circular Cylinders under the Influence of Weak Alternating Fields. E. Hinze. *Ann. d. Physik,* 19. 2. *pp.* 143–154, *Jan.*, 1934.—The theory of the skin effect for ferromagnetic conductors is investigated by a consideration of two hysteresis loop curves as consisting of two parabolic arcs. With the aid of the theory evolved the values of the self-induction and the resistance are utilised to determine the values of the constants μ_0 *i.e.* (the initial permeability) and ϵ (the variation from μ_0). In particular the difference $\mu_R - \mu_L$ is found and gives, to a first approximation, the value of ϵ direct. The theoretical values so obtained are in good agreement with the results of experiment. All earlier work has indicated that the skin effect in cylindrical conductors as calaculated shows that the permeability is independent of the field. The present work evolves a theory which expresses the relationship between the permeability and the field, as also the hysteresis losses, *i.e.*, from a knowledge of the effective self-induction and the effective resistance. S. G. B.

1336. Crystal Structure and Ferromagnetism of the Mn–Al–Cu Alloys. O. Heusler. *Ann. d. Physik*, 19. 2. *pp.* 155–201, *Jan.*, 1934.—The relation between crystalline superstructure and the ferromagnetism of the Mn–Al–Cu alloys is investigated in considerable detail. Structural particulars are derived from X-ray analysis by the Debye-Scherrer method and from measurements of electrical resistance; the magnetic characteristics investigated include the manners of their dependence upon field-strength, temperature, heat treatment and composition of the alloys. J. S. G. T.

1337. Magnetic Changes in Iron and Steel as a Function of Temperature. J. Seigle. *J. de Physique et le Radium*, 5. *pp.* 37–48, *Jan.*, 1934.—The reversible and irreversible transformations in steels and the anomalous behaviour on expansion are discussed. The magnetic properties of ferrite, cementite and pearlite are considered. The differential dilatometer of Chevenard is used to investigate the relation between the magnetic and the dilatometric critical points of various steels. Dilatation-temperature and magnetisation-temperature curves are given for a very mild steel, for C steels with 0·25 and 0·58 % C. and for a 7 % Ni and a Ni-Cr steel. The Curie points in the α-state are discussed with the aid of equilibrium diagrams for the systems Fe-C and Fe-Ni. The state of pure iron at temperatures above 700° C. is discussed, and it is suggested that β-iron is a mixture of α- and γ-iron; this seems to be confirmed by X-ray analysis and a study of the paramagnetic behaviour. H. J. H. S.

1338. Magnetic Susceptibilities at High Temperatures. R. A. Fereday. *Phys. Soc., Proc.* 46. *pp.* 214–230, *March* 1, 1934.—Details are given of an electromagnet which has been specially built for carrying out measurements of small susceptibilities by a method, previously described by the author, in which specially designed pole-pieces are used. It is shown that the method is applicable whether the pole-pieces are or are not saturated. An apparatus for the determination of susceptibilities at high temperatures is described in detail. It is shown that the susceptibility of anhydrous nickel sulphate can be represented by an expression of the form $(\chi - a)(T - \theta) = C$, and that anhydrous nickel cyanide, although having an exceptionally small susceptibility (of the order 3×10^{-6}), behaves as a normal paramagnetic substance, following a Curie-Weiss law for variation of susceptibility with temperature. AUTHOR.

1339. Diamagnetic Susceptibility of Atoms. P. Gombás. *Zeits. f. Physik*, 87. 1–2. *pp.* 57–61, *Dec.* 13, 1933.—The statistical method of W. Lenz and H. Jensen for determining the diamagnetic susceptibility of atoms is used to derive a formula which may be compared with the experimental results and with those predicted by other theories. The formula is found to be in satisfactory accord with experimental results.

H. L. B.

1340. Magnetic Investigation of Organic Radicals. H. Katz. *Zeits. f. Physik*, 87. 3–4. *pp.* 238–244, *Dec.* 23, 1933.—The valency variations of nitrogen have been investigated from the standpoint of magnetic behaviour and the results compared with the Lewis electron-pair theory and the Bose magnetic theory. In agreement with previous investigators, trivalent nitrogen and tetravalent positively charged nitrogen are always diamagnetic, whereas all other degrees of valency are paramagnetic.

H. H. Ho.

1341. Diamagnetism and Paramagnetism in Metallic Mixed Crystals. Part II. E. Vogt and H. Krueger. *Ann. d. Physik*, 18. 7. *pp.* 755–770, *Dec.*, 1933.—In the first part, the magnetic properties of Au alloyed with 1, 2, 4 and 6 % of Ni are investigated. Ni appears in the Au lattice up to the limit of its solubility with a paramagnetism which is constant between 300° and 200° K. An increasing susceptibility with fall of temperature below 200° K, if ascribed to Ni + ions indicates that the ionic concentration does not exceed 1 % of the dissolved Ni atoms. In the second part, the magnetic behaviour of the alloys Cu Pd, Cu_3Pd and Cu_3Pt is discussed. The orderly arrangement of the atoms termed *Überstruktur* is accompanied by a change in the susceptibility of the mixed crystal alloy which cannot be calculated by applying the additive law. [See Abstract 770 (1933) and following Abstract.]

G. E. A.

1342. Diamagnetism and Paramagnetism in Metallic Mixed Crystals. Part III. E. Vogt. *Ann. d. Physik*, 18. 7. *pp.* 771–790, *Dec.*, 1933.—The great majority of the transition metals possess very feeble paramagnetism with little or no dependence on temperature, and the question what has become of the ionic paramagnetism is investigated, and discussed with reference to measurements of the atomic moments of the transition metals in dilute mixed-crystal solutions of Cu, Ag and Au. [See preceding Abstract.]

G. E. A.

1343. Effect of Crystalline Electric Fields on the Paramagnetic Susceptibility of Cupric Salts. O. M. Jordahl. *Phys. Rev.* 45. *pp.* 87–97, *Jan.* 15, 1934.—The paramagnetic susceptibility of the cupric ion in the hexahydrate sulphates $Cu(NH_4)_2(SO_4)_2 : 6H_2O$ and $CuK_2(SO_4)_2 : 6H_2O$ has been computed on the assumption that the crystalline field has monoclinic symmetry but deviates only slightly from cubic symmetry. The computed variation of the *magnitudes* of the principal susceptibilities with temperature agrees with the data over the limited range of experimental measurements. The mean susceptibility should follow quite closely the simple formula $\chi = A/T + B$, even if the individual susceptibilities do not. This agrees very well with the observations of de Haas and Gorter on the mean susceptibility of $CuSO_4 : 5H_2O$ for the temperature range 14° K. to 290° K. In a rhombic field, such as was previously used by Schlapp and Penney for calculations on Co^{++} and Ni^{++}, the directions of the principal magnetic axes are independent of temperature, while the more general monoclinic field gives a rotation of the magnetic axes as the temperature is varied. The calculated variation of the *direction* of the principal axes with temperature in Cu^{++} is in qualitative accord with the observations of Bartlett, but the numerical agreement is not very good. The introduction of an exceedingly asymmetrical diamagnetic correction greatly improves the agreement for the potassium salt, but more likely, the large rotations observed by Bartlett are due to allotropic changes, since the temperature range is not far below the temperatures at which dehydration and decomposition take place. From the choice of parameters which give agreement with the magnetic data, conclusions are drawn about the structures of these crystals. AUTHOR.

1344. Solutions of Maxwell's Equations for Free Space. A. Proca. *Comptes Rendus*, 197. *pp.* 1725–1727, *Dec.* 26, 1933.—The author introduces a single scalar potential Φ from which the six components of electric and magnetic force are derived by the application of six operators specially chosen so that Maxwell's equations are automatically satisfied, at least formally. The operators involve, in addition to familiar forms, expressions of the type $\sqrt{\partial/\partial x}$, $(\partial^2/\partial x^2+\partial^2/\partial y^2)^{-\frac{1}{2}}$, etc., representing *differentiations of fractional order* for which a meaning is obtained in terms of the Fourier expansion of Φ. The solutions given bear on the connection between electromagnetic theory and the quantum theory of photons. W. S. S.

1345. Model of the Electric Field and of the Photon. J. J. Thomson. *Phil. Mag.* 17. *pp.* 197–198, *Jan.*, 1934.—The model proposed [see Abstract 5462 (1933)] is shown to be capable of illustrating the production of positive and negative electrons by γ-rays impinging on matter. G. C. McV.

1346. Change of Magnetic Susceptibility in Metals and Alloys caused by Internal Stress. Y. Shimizu. *Tohoku Univ., Sci. Reports*, 22. *pp.* 915–933, *Dec.*, 1933. *In English. Report No.* 312 *of the Research Inst. for Iron, Steel and other Metals.*—The effect of internal stress or cold-working on the susceptibility of metals and alloys has not yet been completely solved. The present investigation was undertaken to obtain a further knowledge on the same subject, and the following results were obtained: with an increasing degree of internal stress, the paramagnetic susceptibility of metals and alloys decreases, while their diamagnetic susceptibility numerically increases. In the case of an alloy of gold with platinum, its susceptibility is changed by cold-working from paramagnetic to diamagnetic. A theory is proposed, by which the experimental results obtained can be satisfactorily explained in a quantitative way. AUTHOR.

1347. Method of Producing Uniform Magnetic Fields. I. I. Rabi. *Rev. Sci. Instruments*, 5. *pp.* 78–79, *Feb.*, 1934.—The theory is given of a method of obtaining a uniform magnetic field in the space formed (*a*) by boring a cylindrical hole with its axis parallel to the axis of a cylinder carrying a uniform current or (*b*) by removing the lenticular space formed by two intersecting equal cylindrical conductors carrying opposing currents of the same density. H. M. B.

See also Abstracts 876, 1137, 1274.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1348. Scientific Control of Radiographic Results. C. Weyl, S. R. Warren, Jr., and D. B. O'Neill. *Radiology*, 21. *pp.* 546–555, *Dec.*, 1933.—Radiographs taken at different times, even in the same laboratory, are not comparable, owing to the large number of varying factors, of which ten are listed, one of which, namely, dependence upon the X-ray film, involves three sub-factors. The radiologist's interest is chiefly in the direction of film quality, and a method of measuring the photographic density, by means of an aluminium stepped penetrometer, is described, and curves are illustrated for variations in respect to developing time, temperature of developing solution, tube voltage, tube current, and exposure times. Further curves show the variations given by differing photographic film material. The varying factors are briefly discussed, particularly in respect to the effect of the X-ray tube and the h.t. exciter. Finally, the authors comment upon the personal factor, resulting from the varying views of radiologists. Future standardisation will only be possible with the collection of further data, and a method is suggested in which a small aluminium scale is fixed at the corner of the film cassette, during each exposure, so as to allow of standardisation. B. J. L.

1349. Thermal Phenomena in the Biological Action of Ultrasonic Waves. E. and H. Biancani and A. Dognon. *Comptes Rendus,* 197. *pp.* 1693–1694, *Dec.* 18, 1933.—Observations have been made on the rise in internal temperature of a number of substances when placed in an ultrasonic field. Colloidal solutions show little or no temperature-rise, but fatty substances and animal tissues show considerable rises, in some cases as much as 25° C. in 30 sec. It is suggested that the lethal action of ultrasonics on small aquatic animals, may be due to selective heating of some organ or other, probably the brain. J. E. R.

See also Abstract 1119.

OSCILLATIONS.

1350. Types of Electric Oscillations. J. Mercier. *Comptes Rendus,* 198. *pp.* 349–351, *Jan.* 22, 1934.—A brief discussion is given of the various types of oscillation which may be obtained in a valve circuit of the type in which an oscillatory circuit is connected in the valve anode circuit and a coil in the grid circuit is used for reaction purposes. The oscillations dealt with include (1) simple oscillations obtained with little reaction, (2) saturation oscillations, where the working point on the characteristic passes beyond the saturation point, (3) shock oscillations, in which it appears as if at every half period the circuit receives a shock just at the instant when the potential across the condenser is zero, (4) relaxation oscillations. Oscillations as usually obtained are frequently combinations of two or more of the above types. A. W.

1351. General Theory of Electric Oscillatory Circuits. E. Hallén. *Arkiv f. Mat., Astron. och Fysik, Stockholm,* 24*A. No.* 5. [38 *pp.*], 1933. *In German.*—Formulæ are derived which enable the potential and current distribution and also the natural frequencies of coils of given dimensions to be determined. A. W.

1352. Overtones and Fundamental Period of an Electric Oscillatory Circuit. E. Hallén. *Phil. Mag.* 17. *pp.* 192–197, *Jan.,* 1934. —Experimental verifications are described of formulæ previously obtained [see preceding Abstract] for the natural frequencies of simple oscillatory circuits. Exact agreement was not obtained between the theoretical and observed frequency values, but the differences were in no case large, and the sources of the discrepancies are discussed. A. W.

1353. Sub-Harmonic Frequencies Produced in Non-Linear Systems. W. M. Goodhue. *Frank. Inst., J.* 217. *pp.* 87–101, *Jan.,* 1934.—It is well known that a sine wave operating through a non-linear device gives a distorted wave containing harmonics and possibly even a uni-directional component. The converse of this is also found to be true, so that a wave containing no component whatsoever of fundamental frequency, but containing only higher harmonics, when operating through a non-linear device, may give rise to a fundamental component, while at the same time a change of amplitude of the original harmonics may occur and harmonics of new frequency may appear. The fact that a wave consisting of two harmonic components has a period equal to that of the fundamental, although the resultant wave contains no fundamental component whatever, is shown by consideration of the wave $y = A\sin 3\theta + B\sin 5\theta$. When this wave becomes distorted it still retains the period of $C\sin\theta$ and usually will contain a component $C\sin\theta$. Examples from valve circuits and magnetic circuits are discussed. A. W.

See also Abstracts 1255, 1259, 1273.

PHOTOELECTRICITY.

1354. Theory of Photoelectric Effect in Crystals. H. Teichmann. *Zeits. f. Physik*, 87. 3–4. *pp.* 264–272, *Dec.* 23, 1933.—Various objections that have been raised to the author's theory of the photoelectric effect in crystals [see Abstract 1662 (1933)] are discussed, and research is described which shows that the results given by Deaglio in support of his hypothesis concerning the electrolytic conductivity of cuprite under illumination can be explained on the basis of the temperature coefficient of the crystal-photoelectric effect. A. W.

1355. Theory of the Photoelectric Current across a Metal Semi-Conductor Contact. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 30. *pp.* 55–58, *Jan.* 31, 1934.—Nasledow and Nemenow [see Abstract 3257 (1933)] have recently found that the direction of electron flow in the "Vorderwandeffekt" remains normal for ultra-violet illumination in a region in which the photoelectric yield from the metal to vacuum would be much greater than the yield from Cu_2O to vacuum, and have suggested that this may constitute a difficulty for the current theory. In the present note it is shown that the experimental results referred to above appear to be a natural consequence of this theory, provided that we may assert that the efficiency of a highly localised electron on an impurity as an absorber of light is comparable with that of an electron in a free atom, and thus so large compared with that of a non-localised metallic electron or electron in a running level of the semi-conductor that the total photoelectric absorption by the impurity electrons is more important than that of the much more numerous electrons in the main levels. L. A. W.

1356. Effect of Alkali Ions on the Photoelectric Emissivity of Tungsten. A. K. Brewer. *Phys. Rev.* 44. *pp.* 1016–1019, *Dec.* 15, 1933. —Known quantities of Na^+, K^+, Rb^+ and Cs^+ ions were deposited on tungsten and the changes in the photoelectric current measured. For wave-lengths below 2800 Å the current increases proportionally to the fraction of the surface covered as long as f is small. The emissivity for longer wave-lengths is low at first, and then rises sharply beyond some critical value of f, which increases with the wave-length. The results indicate that the work function is not uniform over these composite surfaces; this makes it impossible to fix a definite threshold for the various values of f. The emissivity increases with temperature to about 500° C., where fatigue becomes appreciable. As the filament fatigues for photoelectric emission the positive ion emissivity increases, reaching a maximum when the threshold returns to that for clean tungsten. The results show that the alkali dissolves so rapidly in the tungsten that the dependence of the work function on f cannot be determined at temperatures above 500° C. AUTHOR.

1357. Sensitivity of Photoelectric Cells of Different Types. W. Kluge and H. Briebrecher. *Zeits. f. techn. Physik,* 14. 12. *pp.* 533–538, 1933.—For the loose term "sensitivity," as applied in an indefinite manner to photoelectric cells, the authors substitute the precisely defined terms spectral sensitivity, current sensitivity, voltage sensitivity and power sensitivity. The properties of the three different types of cell (resistance, alkali and blocking-layer) are then discussed [see Abstract 1731 (1932)], the results obtained being of practical use in the selection of the most suitable type of cell for a given purpose. L. A. W.

1358. Fatigue Effects in Gas-Filled Alkali Photoelectric Cells. H. Janssen. *Zeits. f. Astrophysik,* 7. *pp.* 249–271, *Nov.* 12, 1933.—The fatigue effect was investigated in potassium kathodes sensitised by a glow discharge in hydrogen. It was first established that the degree of sensitisation increased as the time of the discharge increased; it rose to a maximum for quite a short time of discharge, and did not increase further for longer times. The fatigue effect increases as the time of sensitisation increases. If pure potassium is used there is no fatigue effect for short times. It is suggested that when the discharge ceases a thin layer of potassium condenses on to the hydride surface formed by the discharge and that the longer the discharge continues the less potassium vapour remains to form this layer. The fatigue effects are then attributed to the formation of a layer of ions on the surface. This layer will show less tendency to form the more complete the layer of potassium, thus accounting for the increase of fatigue effects with increase of time of sensitisation. Support for the theory is found in the fact that no fatigue occurs when a thin layer of potassium is deliberately formed on the hydride surface. Cells showing no fatigue effects did not necessarily give a linear current-intensity curve. D. H. F.

1359. Response of Selenium Rectifier Photoelectric Cell to Weak Illuminations. H. C. Hamaker and W. F. Beezhold. *Physica,* 1. 2. *pp.* 119–122, *Dec.,* 1933. *In German.*—A selenium rectifier photoelectric cell of the "Vorderwand" type was illuminated by monochromatic light of various wave-lengths, the current in all cases being about 2×10^{-9} ampere. In general, the current continues to rise for some minutes under steady illumination. The initial rate of increase is greater for greater wave-lengths, and for greater concentrations of the light on the surface. The return to zero after the light is cut off behaves similarly. D. H. F.

1360. Properties of the Selenium Rectifier Photoelectric Cell and its Use for Meteorological Measurements. W. Grundmann and L. Kassner. *Phys. Zeits.* 35. *pp.* 16–20, *Jan.* 1, 1934.—Cells of the type developed by Bergmann [see Abstract 3262 (1933)] were tested under illuminations giving currents up to about 50 mA. It was found that when the cell was exposed to a constant illumination for some days the current fell slowly to a steady value, at a different rate for different cells and different illuminations; a complete regeneration occurs if the cell is put in the dark for about 30 min. however, and on subsequent illumination the steady value is attained in about the same time. In consequence, the current under a given illumination depends upon the past history. No appreciable temperature effect was discovered, nor any ageing effect when the cell was kept in the dark. It is concluded that the cell is unsuitable for the registering of intensities over long periods, as in meteorological radiation observations. D. H. F.

1361. Illumination-Response Characteristics of Vacuum Photoelectric Cells of the Elster-Geitel Type. J. S. Preston and L. H. McDermott. *Phys. Soc., Proc.* 46. *pp.* 256–272; *Disc.*, 272–276, *March* 1, 1934.—The authors deal with the present status of the vacuum photoelectric cell as regards proportionality of photoelectric current to incident illumination, and give a series of observations which show that, while excellent cells are obtainable, their employment for precise work without a previous test is unsafe. A theory is developed which accounts for the observed results and gives over a limited range an equation of the form $S=K_1+K_2/\sqrt{E}$, where S is the cell-sensitivity and E the illumination. Attention is called to the dependence of the illumination characteristic upon the colour of the light employed. The bearing of the theory on the application of Talbot's law to non-linear photoelectric cells is discussed. AUTHORS.

1362. Ionisation of Cæsium Vapour by Ultra-Violet Light. J. Kunz. *Phil. Mag.* 17. *pp.* 483–491, *Feb.*, 1934. *Supplement.*—A new method has been applied for the determination of the photoelectric effect of cæsium vapour. The photoelectric current has been amplified by a G.E. F.P.54 amplifier. The coulombs liberated per erg of the incident beam and the atomic ionisation coefficient have been determined for wave-lengths between 3130 and 2400 Å, and for three temperatures of 25°, 75°, and 125° C. AUTHOR.

1363. Photo-Resistance. Q. Majorana. *Accad. Lincei, Atti,* 18. 5–6. *pp.* 184–188, *Sept., and* 18. 7–8. *pp.* 260–265, *Oct.*, 1933.—Continues previous work [see Abstract 3250 (1933)] with deposited films of Al and Na. The effect, a pulsating variation in the electric resistivity under the impact of light, seems to be not purely thermic in its nature. A description is given of various types of compensating apparatus. A. D.

1364. Photoconductivity of a Metal Film Situated in Running Water. Q. Majorana. *Accad. Lincei, Atti,* 18. *pp.* 347–352, *Nov.* 5, 1933.—Experiments are continued [see Abstract 2088 (1933)] to distinguish between thermal effects and pure photo-effects, on the electrical resistance of a thin metal film under illumination. A thin film of platinum on glass was placed in running water and illuminated with intermittent light from a mercury-vapour arc lamp. The conditions were those of turbulent flow and the thermal effects were therefore much reduced by the forced convection. It is concluded that changes in the electrical resistance are brought about by a direct photo-effect and cannot be entirely explained on thermal grounds. F. C. C.

1365. Photoconductivity in a Metal Film Illuminated by Intermittent Light. Q. Majorana. *Accad. Lincei, Atti,* 18. *pp.* 433–437, *Nov.* 19, 1933.—An experimental arrangement is decribed by means of which the frequency of interruption of the light can be raised to 16,000 per sec. The effect, which consists in an increase in the electrical resistance of a thin metal film when so illuminated, decreases as the frequency increases but less rapidly than the ordinary photoelectric effect. A summary of work published previously by the writer, describing the behaviour of the effect under various physical conditions [see preceding Abstract] is appended. F. C. C.

1366. Photoelectric Titration. F. Müller. *Zeits. f. Elektrochem.* 40. *pp.* 46–51, *Jan.*, 1934.—A general discussion is given of the methods of registering the end-point of a titration (*i.e.*, the colour change of the indicator) by means of the change of response of a photoelectric cell illuminated by light transmitted through the liquid. A description is given of a circuit involving a vacuum or gas-filled cell and an amplifying valve. It is pointed out that a much simpler arrangement is possible using blocking-layer cells, which also have a sensitivity approximating more nearly to that of the eye. Examples are given of actual measurements with a simple bridge arrangement using two blocking-layer cells to compensate for fluctuations of the light source. L. A. W.

See also Abstract 1121.

PIEZOELECTRICITY.

1367. Modes of Vibration of a Piezoelectric Crystal. H. Straubel. *Phys. Zeits.* 34. *pp.* 894–896, *Dec.,* 1933.—Piezoelectric crystals are arranged parallel to the second mirror of a Michelson interferometer. When the crystal is made to vibrate the nodal lines appear. The modes of vibration of crystals of different orientation, thickness and diameter are discussed, and are illustrated by photographs. H. J. H. S.

1368. Optical Investigation of the Form of Vibration of Piezoelectric Oscillators in Liquids. E. Hiedemann and H. R. Asbach. *Phys. Zeits.* 35. *pp.* 26–28, *Jan.* 1, 1934.—The unhomogeneousness of the sound field which is produced by the form of vibration of a piezo-quartz was investigated by an optical method the same in principle as that used by Bär and Meyer [see Abstract 3498 (1933)] in which the fact that a liquid traversed by ultrasonic waves of high frequency acts like an optical grating is applied. Convergent light from an electric lamp and a perforated diaphragm with a vertical series of holes were employed, and photographs of the diffraction images were obtained showing the energy distribution in layers of the liquid. In some cases the simpler arrangement of a slit instead of a series of holes was used. J. J. S.

See also Abstract 938.

THERMIONICS.

1369. Transformation of Metals and Secondary Electron Emission. K. Hayakawa. *Tohoku Univ., Sci. Reports,* 22. *pp.* 934–958, *Dec.,* 1933. *In English. Report No.* 313 *from the Research Inst. for Iron, Steel and other Metals.*—The purpose of the present investigation was to study the transformation in metals by measuring the secondary electron emission excited by thermionic current, or by measuring ionisation current in a high-vacuum tube, at various temperatures. Each of these two methods proved itself to be very successful. In the case of allotropic changes in iron and cobalt, these currents varied abruptly at the transformation points. In the case of the magnetic transformation in iron, nickel, iron-nickel alloys, the variation of the electron emission or of the ionisation current with the rise of temperature is quite continuous, as to be expected from the nature of that transformation ; the same variation with respect to the course of the electron current above the critical point changes its sign above and below the critical voltage of the exciting thermionic current. The existence of the critical voltage can be explained from the view-point of Richardson's structure electron. AUTHOR.

THERMOELECTRICITY.

See Abstract 1213.